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For related information see also *Astronautics*.

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Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 135
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences*.

88 SPACE SCIENCES (GENERAL) 137

89 ASTRONOMY 137
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 138
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 138
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

92 SOLAR PHYSICS 139
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 139
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

GENERAL

99 GENERAL N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

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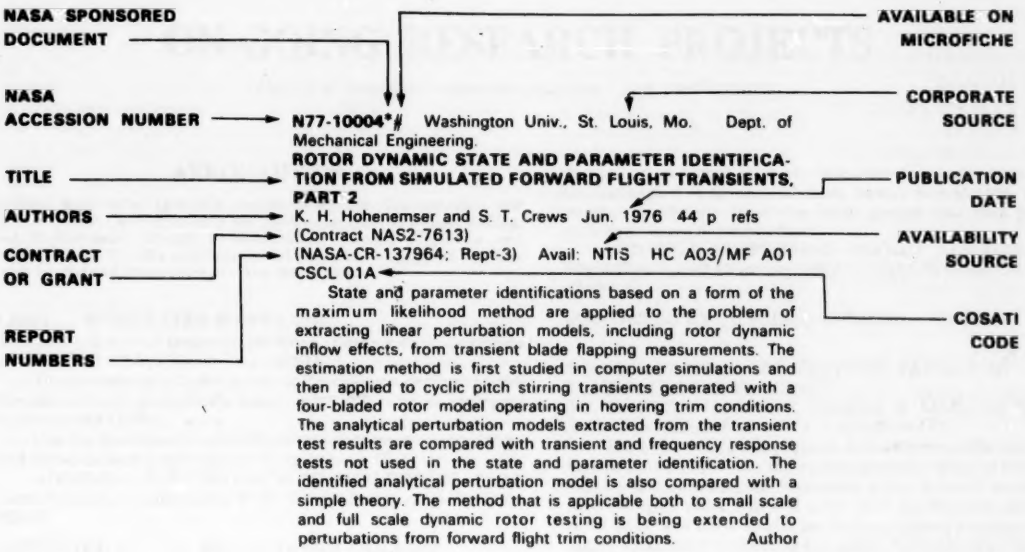
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N77-10004*# Washington Univ., St. Louis, Mo. Dept. of Mechanical Engineering.
CORPORATE SOURCE
TITLE
ROTOR DYNAMIC STATE AND PARAMETER IDENTIFICATION FROM SIMULATED FORWARD FLIGHT TRANSIENTS, PART 2
PUBLICATION DATE
AUTHORS
K. H. Hohenemser and S. T. Crews Jun. 1976 44 p refs
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REPORT NUMBERS
State and parameter identifications based on a form of the maximum likelihood method are applied to the problem of extracting linear perturbation models, including rotor dynamic inflow effects, from transient blade flapping measurements. The estimation method is first studied in computer simulations and then applied to cyclic pitch stirring transients generated with a four-bladed rotor model operating in hovering trim conditions. The analytical perturbation models extracted from the transient test results are compared with transient and frequency response tests not used in the state and parameter identification. The identified analytical perturbation model is also compared with a simple theory. The method that is applicable both to small scale and full scale dynamic rotor testing is being extended to perturbations from forward flight trim conditions. Author

ON-GOING RESEARCH PROJECTS

This is a listing of research projects - not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, INTEGRATED POWER UNIT

G. WOND, Rockwell International Corp., *Canoga Park, California* 91304 (DF459090; F33615-76-C-2054)

To demonstrate a turbo power unit which can perform all the functions of both an auxiliary power unit (APU) and an emergency power unit (EPU).

Use the background available from space program to design and fabricate such a unit which will operate on JP-4.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Aero-Propulsion Laboratory POP, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0002, ANALYSIS OF HELICOPTER DRIVE SYSTEM ON-CONDITION MAINTENANCE CAPABILITY

W. TRUSTEE, Sikorsky Aircraft Company, *Stratford, Connecticut* 06602 (DA0D3942; DAAJ02-74-C-0045)

To determine the capability of CH-53 and CH-54 helicopter transmissions and gearboxes to operate without the necessity of scheduled overhauls.

The methodology described in USAAMRDL Technical Report 73-58, 'Analysis of Criteria for On-Condition Maintenance for Helicopter Transmissions,' will be used to analyze failure and depot overhaul data for the CH-53 and CH-54 transmissions. In addition, a failure modes and effects and criticality analysis (FMECA) will be performed.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0003, VARIANCE IN FATIGUE CRACK PROPAGATION

B.M. HILLBERRY, Purdue University, School of Engineering, *Lafayette, Indiana* 47907 (DF138680; AF-AFOSR-3018-76)

The accuracy of crack life predictions required by USAF MIL-A-83444 depends on the accuracy of the constant amplitude crack growth rate data on which they, the predictions, are based. The objective of this effort is to relate the variance in fatigue crack growth rates to the variance in crack growth lives and thereby determine the accuracy required in describing constant amplitude fatigue crack growth rates. The return on this investment will be more accurate crack growth life-prediction capability that can be utilized to establish aircraft structural safety and durability.

Constant amplitude fatigue crack growth rate data provide the analyst with the necessary baseline data for predicting crack growth lives. These baseline data are generated by numerical differention of discrete experimental crack length vs. cycle data points. This effort employs a systematic procedure for evaluating the variance in crack growth rate data due to (a) point-to-point material differences, (b) numerical differentiation techniques, and (c) crack length vs. cycle data collection techniques. Unless the variance due to each of these factors is evaluated, it is not possible to discern from the crack growth rate data potential variations in crack growth lives.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Flight Dynamics Laboratory FBEC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0004, FATIGUE AND FRETTING FATIGUE OF TITANIUM HELICOPTER FORGINGS

T.S. DESISTO, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0C4815)

The objective of this program is to determine the microstructure required to provide the optimum combination of fatigue and fretting fatigue resistance of titanium alloys in heavy-section form for helicopter rotor hub and drive shaft applications. Helicopter rotor hubs and drive shafts are fatigue critical components and highly susceptible to fretting corrosion. Fretting, when combined with fatigue loading, can result in a drastic decrease in the life of helicopter components. Materials subjected to press fits and connections subjected to small oscillatory motions are likely candidates for fretting. The program thrust is in the aircraft area of survivability.

Fatigue life and fretting corrosion data will be obtained on titanium alloys subjected to various heat treatments and process variables. Various fraying surfaces will be examined. Data obtained will be correlated with fractographic features, mechanical properties and microstructure.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Research Center, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

1.0005, BEHAVIOR OF CASE-HARDENED GEAR AND BEARING MATERIALS

P.J. FOPIANO, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0D4755)

The objective of this program is to investigate the metallurgical properties of new and improved case, hardened gear and bearing materials used in the manufacture of high-performance components for Army aircraft and armored vehicles. Of particular importance are high-speed applications as found in helicopter transmissions and high-torque applications as found in the drive strain of armored vehicles. Improvements will be sought in the residual life of case hardened components by the optimization of the metallurgical structure. This project thrust is survivability.

Emphasis in FY 76 will continue to be on gear materials. The optimization of the metallurgical structure will be undertaken by the control of the carburizing, heat treatment, and processing procedures of candidate materials. The effect of these processing procedures on microstructure (including ferrite, retained austenite, and transformation products), macrostructure (including segregation and inclusion content) and residual stress will be evaluated. Emphasis during FY 76 will be on carburized VASCO X-2 and 9310 in the vacuum- melted (VAR) and electroslag-melted (ESR) conditions. Possible correlation of the various physical and mechanical properties with gear performance will be undertaken.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Research Center, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

1.0006, EFFECTS OF LOW-YIELD NUCLEAR WEAPONS ON AIRFIELDS AND RAILWAY SYSTEMS (ESSEX VI)
L.K. DAVIS, U.S. Army, Waterways Experiment Station, *Vicksburg, Mississippi* 39180 (DA0D8183)

The objective of this study is to provide a reliable means of predicting the effectiveness of ADM's on air-delivered nuclear weapons employed against airfields and railroads. Relative effectiveness will be measured by damage to critical system components and time and effort required for hasty and deliberate repair, and in terms of nonoperational times, during which aircraft takeoffs and landings or rolling stock passage cannot take place.

The approach will consist of: (a) an experimental program to model weapons explosion effects under realistic conditions at both small and intermediate scales, and (b) an analytical effort to extrapolate the empirical results to full-scale weapons and typical airfield/railroad systems.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: OCE Waterways Experiment Station, PO Box 631, Vicksburg, Mass. 39180

SUPPORTED BY U.S. Dept. of Defense - Army

1.0007, LOW-LEVEL NIGHT OPERATIONS OF ARMY AIRCRAFT
D.C. JOHNSON, U.S. Army, Avionics Laboratory, *Red Bank, New Jersey* 07703 (DA0C3426)

To define the necessary avionics equipment to enable an Army pilot to fly low at night and under limited visibility conditions.

The approach being taken consists of a simulation effort on the tactical avionics systems simulator, flight tests in an environment aircraft for avionics research (EVAR) and modified operational aircraft, and an experimental measurement program for sensor capability assessment. A threat exists to Army aircraft operating in a tactical environment in a low- to mid-intensity conflict from hostile air defense weapons, such as tracked optical/radar directed antiaircraft weapons, optical/radar directed guns, shoulder fired heating seeking missiles, etc. The optical directed weapons could also be augmented by night vision equipment. To counter this threat, Army aircraft must adopt the tactic of low-level flight to take advantage of natural masking offered by terrain. Operations at night and under reduced visibility conditions at low levels will appreciably increase the effectiveness of Army aircraft.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ECOM Avionics Laboratory, Ft. Monmouth, N.J. 07703

SUPPORTED BY U.S. Dept. of Defense - Army

1.0008, DYNAMIC TESTING OF UTTAS YUH-61A SEATING SYSTEMS
N. CARAVASOS, Boeing Company, *Philadelphia, Pennsylvania* 19142 (DA0D4014; DAAJ02-75-C-0048)

To purchase prototype UTTAS YUH-61A seating systems for later evaluation of their crashworthiness.

These seats will be dynamically tested to the requirements of MIL- S-58095 and USAAMRDL TR 71-22. The testing will be performed by the Crew Systems Division, Naval Air Development Center, Warminster, PA, during FY 76.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0009, AIRLOADS PREDICTION TECHNIQUE
R. RUDNICKI, L T V Aerospace Corporation, *Dallas, Texas* 75222 (DF639460; F08635-76-C-0237)

The objective is to modify, computerize, and validate a technique to predict aerodynamic loads on external stores during carriage on aircraft. The technique has already been developed under a previous contract and uses empirical data to compute six-component captive airloads for both single and multiple carriage configurations. With such a technique available on the computer, it will be possible to evaluate new weapon and aircraft designs without resorting to expensive wind-tunnel or flight testing.

The approach will be to first computerize part of the technique, check it against available wind-tunnel data, and then, if successful, complete the computerization process. The wing single carriage case will be investigated first, and airloads data from the 1/9-scale F-16 wind- tunnel test will be used for comparison. In addition, the technique will be modified to increase the angle-of-attack accuracy range for yawing moment.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Armament Laboratory DLJC, Eglin AFB, Fla. 32542

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0010, HT-ST 72-3 ADVANCED STRUCTURAL DESIGN CONCEPTS FOR ARMY AIRCRAFT
I.E. FIGGE, U.S. Army, Air Mobility Res. & Dev. Lab., *Newport News, Virginia* 23604 (DA0C4009)

To develop improved structural design concepts through fabrication and test of structural components utilizing composite materials, to establish payoffs in increased structural efficiency, reduced vulnerability, increased safety and reliability, and reduced fabrication costs of future Army aircraft systems.

Tetra-core panels and shafts will be fabricated and basic structural characterization determined. A tetra-core secondary structure will be designed, fabricated and structurally evaluated. Data will be evaluated and a report written showing the comparative results in terms of structural efficiency, productivity, survivability and risk. Various structural concepts for an AH-LG synchronized elevator will be evaluated to determine the optimum cost and structural design. A detail design will be conducted on the selected concept.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Lab., Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0011, HT RM 75-21- ARMY HELICOPTER INTERNAL CARGO RESTRAINT EXPERIMENT
S. HOLA, U.S. Army, Air Mobility Res. & Dev. Lab., *Newport News, Virginia* 23604 (DA0D3963)

To determine the adequacy of cargo restraint criteria in a survivable helicopter crash.

Install an experimental payload in the cargo area of a CH-47B helicopter that is planned to be crash-tested at NASA-Langley. Payload and tie-down devices will be instrumented and developed loads recorded. Recorded data will be analyzed. A report of the test results will be prepared.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Lab., Eustis Directorate Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0012, HT 75-31- AIRCREW PROTECTIVE DEVICES (ARMOR AH-LG)
E.M. PARD, U.S. Army, Air Mobility Res. & Dev. Lab., *Newport News, Virginia* 23604 (DA0D4003)

To pursue the techniques of application of armor systems to Army aircraft to include protection against 14.5mm projectiles and fragments emanating from functional 23mm HEI projectile threats by designs, fabrication, installation and experimentation to produce positive application of evolving armor material and protective techniques.

The following work will be conducted in-house: preliminary designs, mock-up fabrication, installation of mock-ups, fit check, modifications to design mock-ups, attachment bracketry, final design drawings and installation handbook for two (2) armor systems that will provide protection to the aircrew of the AH-LG (COBRA) helicopter against 14.5mm and 23mm HEI threat

levels; operational tests/evaluation of armor systems shall be conducted at Ft. Rucker. The following work shall be conducted under contract: armor system - one (1) EA shall be procured under contract for the AH-LG (COBRA) helicopter. The systems shall be fabricated in accordance with government-furnished drawings and specifications.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0013, HT 74-14- BALLISTIC TESTING, ARMY AIRCREW AND CRITICAL COMPONENT PROTECTIVE DEVICES

C.M. PEDRIANI, U.S. Army, Air Mobility Res. & Dev. Lab., *Newport News, Virginia* 23604 (DA0D3912)

To provide ballistic testing of critical component and aircrew protective devices and to validate design criteria that increase the ballistic survivability of Army aircraft.

To conduct experimental firing programs in conjunction with design, fabrication, and ballistic test to evaluate: (1) fuel fog inerting concepts to reduce inflight fuel fires in helicopters; (2) fuel tank materials to increase the survivability of the AH-LG to 14.5mm API projectiles; (3) fuel tank materials to increase the survivability of the AH-LG to 23mm HEI projectiles; (4) ballistic tolerant drive shafts/aircrew transparent and opaque armor upgrade; (5) support of other area missions, e.g., aircraft structures and flight controls; (6) miscellaneous support, e.g., installation, test, and evaluation UTTAS plus HLH.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R.& D Lab., Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0014, HT RM 75-15- EXPERIMENTAL INVESTIGATION OF THE MECHANICAL PROPERTIES OF ELASTOMERIC BEARINGS FOR ARMY AIRCRAFT

J.W. SOBCZAK, U.S. Army, Air Mobility Res. & Dev. Lab., *Newport News, Virginia* 23604 (DA0D3842)

The primary objective of this program is an investigation of the mechanical properties (static and dynamic spring rate) of elastomeric bearings in the temperature range 100 degrees F to -65 degrees F with primary emphasis on the low end of this range. Fatigue properties and ballistic tolerance will also be investigated. Data resulting from this program will support the development of a design manual for elastomeric bearings which will lend to improved R & M for future systems. It will also support climatic hangar testing of the 540 ALL elastomeric bearing rotor system (AH-1 and UH-1 aircraft) and provide data for the design of improved systems for future Army aircraft.

An elastomeric bearing test specimen will be instrumented with implanted thermocouples which will enable internal temperatures to be monitored. The test bearing will then be mounted in a test fixture, placed into an environmental chamber and run down to a low temperature. Static spring rates will be checked initially. Next the bearing will be cycled and dynamic spring rate and internal temperatures will be measured as a function of frequency and magnitude of angular oscillation.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AVSCOM Air Mobility R & D Lab., Eustis Directorate, Ft. Eustis, Va. 23604

SUPPORTED BY U.S. Dept. of Defense - Army

ASTRONAUTICS

Includes Astronautics (general); Astrodynamics; Ground Support Systems and Facilities (space); Launch Vehicles and Space Vehicles; Space Transportation; Spacecraft Communications; Command and Tracking; Spacecraft Design, Testing, and Performance; Spacecraft Instrumentation; and Spacecraft Propulsion and Power. For Related Information See Also Aeronautics.

2.0001, SYNCHRONOUS SATELLITE MOTION

P.E. NACOZY, Univ. of Texas, School of Engineering, *Austin, Texas* 78712

DESCRIPTION: We are developing an analytical theory for the motion of an artificial Earth satellite that is synchronous with the rotation of the Earth. The theory takes into account all the resonant perturbations acting on the satellite as well as forces due to the Sun, the Moon, and solar radiation pressure.

SUPPORTED BY University of Texas

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, CREEP AND DIFFUSION COEFFICIENTS IN SOLID SOLUTIONS

G.M. POUND, Stanford University, School of Engineering, *Palo Alto, California* 94305 (DMR74-00320 A02)

This is the final phase of a study of stress-assisted diffusion in binary alloys. To date, a linked-flux analysis was made to determine whether there was any theoretical basis for a semi-empirical approach which has been successful in describing the creep anomalies of Au-Ni alloys. The results fully verify Norring's equations for microcreep and indicate that there is no theoretical basis for the success of the semi- empirical approach. Also, the results of the current experimental investigation of the Al-Zn system do not confirm the anomalies predicted by other investigators utilizing the semi-empirical approach. However an attempt to compare the 'theoretically appropriate' diffusion coefficient with the 'apparent experimental' diffusion coefficient has lead to seemingly contradictory results, namely, the 'appropriate theoretical' diffusion coefficient decreases in a region of composition where the 'apparent experimental' diffusion coefficient increases. In this last phase, the experimental investigation of the Al-Zn systems will be completed in order to resolve the contradictions. This work should lead to a formulation for the appropriate diffusion coefficient to describe creep in binary solid solutions. This is a renewal of NSF grant DMR7400320.

SUPPORTED BY U.S. Natl. Science Foundation

3.0002, NEW PERFLUOROPOLYMER-FORMING REACTIONS

M.S. TOY, Science Applications Inc., *Sunnyvale, California* (DF042390; F44620-76-C-0027)

Technical objective - new and improved thermally stable elastomers are needed as containment materials such as fuel tank and hydraulic system seals, expulsion bladders, etc., for advanced aircraft, aerospace and missile systems. The objective of this research is to study the nature of C-F bond dissociations and additions to unsaturated perfluorocarbon bonds and to demonstrate polymer-forming reactions that can be utilized to synthesize perfluoropolymers with elastomeric properties over a broad temperature range. Approach - the research will study the dissociation of the covalent C-F bond by homolytic and heterolytic cleavages and the nature of addition of the O-F bond to unsaturated perfluorocarbon bonds from perfluoroolefins, perfluorodienes, perfluoroaromatics, and perfluoroheterocyclics under free-radical, anionic, and cationic environments. The study will include new perfluoropolymer-forming reactions identified in the research involving reactions of primary and tertiary mono- and di- fluoroxyperfluoroalkanes and primary and tertiary perfluorodialkyl peroxides with mono- and di-perfluoroolefins, perfluoroaromatics, and perfluoroheterocyclics.

SUPPORTING AGENCY ADDRESS INFORMATION: AF Office of Scientific Research NC, Bldg. 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0003, STUDY OF THE ALLOYS OF TRANSITION METALS

P.A. BECK, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (GH-37568X)

Magnetization vs. field and temperature was measured for the alloys Cu91Mn9 and Cu75Mn25 in both the quenched and the 100 degrees C aged condition. The results for pairs of ad-

jacent isotherms were analyzed in terms of the sum of a Brillouin function and in terms of a field- independent susceptibility. It was found that the average giant dipole moment increased with decreasing temperature in all four cases and that, at a given alloy composition and temperature, it was larger in the aged condition than as quenched. The neutron diffuse nuclear scattering results of Sato et al. have shown a distinct increase in the atomic short-range order in Cu75Mn25 on aging. The average size of the atomically ordered regions in the aged 25 at % Mn alloy, estimated from the neutron results, is consistent with the average giant moment derived from the magnetization data, assuming that all Mn moments in an atomically ordered region are ferromagnetically coupled with each other.

SUPPORTED BY U.S. Natl. Science Foundation

3.0004, DELAYED FAILURE AND AGING OF MELT-SPRAYED CERAMIC-METAL BONDS IN PHYSIOLOGICAL MEDIA

S.D. BROWN, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DMR76-03893)

This research will be a study of the mechanisms of aging and delayed failure of melt-sprayed ceramic-metal bonds in physiological media. Attention will be focused upon the effects of the character of the ceramic-metal interface and the makeup of the physiological environment on aging and delayed failure. The melt-sprayed ceramic- metal systems to be studied are: alumina on 316L stainless steel, alumina on titanium, and alumina on a cobalt-base alloy. Tensile and shear pull-off tests will be used to obtain quantitative values for adherence in connection with aging and delayed failure experiments. Physiological media to be used include deionized water, stablizied bovine blood, and saline solution. Experiments will be performed to ascertain the effects of chelation, ion exchange, hydration and surface charge. The results will be analyzed in terms of a hypothesis based on multibarrier kinetics.

SUPPORTED BY U.S. Natl. Science Foundation

3.0005, FUEL VULNERABILITY REDUCTION

J.T. DEHN, U.S. Army, Ballistic Research Labs., *Aberdeen Proving Ground, Maryland* 21005 (DA0M4554)

To reduce fuel fire hazards in military combat vehicles and aircraft.

The results of laboratory tests using combinations of additives in fuels will be compared with the results of munitions tests.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Ballistic Research Labs., Aberdeen PG, Md. 21005

SUPPORTED BY U.S. Dept. of Defense - Army

3.0006, THE ELECTRONIC PROPERTIES OF GRAPHITE

M.S. DRESSELHAUS, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DMR76-12226)

This research is concerned with two aspects of the electronic properties of graphite: (1) Studies on the pressure dependence of the graphite electronic structure to gain a better understanding of why this material is semimetallic. The magnetoreflection technique will be the principal tool in this study. This work will be completed during the grant period. (2) The effect of intercalation (with bromine and other donors; and with potassium and other acceptors) on the graphite electronic, lattice, and structural properties. In this work, magnetoreflection, Raman scattering, electron microscopy, conductivity and Hall effect measurements will be made. This investigation will comprise the major portion of the research program.

This is a renewal of NSF Grant DMR74-13245.

SUPPORTED BY U.S. Natl. Science Foundation

3.0007, BASIC RESEARCH IN CRYSTALLINE AND NONCRYSTALLINE CERAMIC SYSTEMS

W.D. KINGERY, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (E(11-1)2390)

Projections indicate that ceramics for nuclear fuels and other applications will be critical in nuclear power development and become major products of the ceramic industry. Thus, development of new understandings of broadly applicable phenomena in crystalline and polycrystalline ceramics seems certain to be applicable to the Administration's responsibilities. These considerations have led us to continue efforts on fluoride-structure materials and on non- stoichiometry, solid solutions and grain-boundary phenomena in oxide systems. Studies include diffusion, precipitation, non-stoichiometry, lattice defects, deformation, sintering, electrical and dielectric properties of ceramics.

RESULTS: Our program to date includes: Structure determinations of highly defective materials, thermodynamics of lattice defects, solutes and their interactions in crystals and as influenced by grain boundaries, transport of lattice defects, ions and polycrystalline ceramics. These, in combination with phase equilibria, are broadly applicable to phase changes, microstructure evolution in sintering and hot pressing, diffusion-controlled creep, pore migration and atom segregation in thermal gradients and electrical conduction in ceramics.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

3.0008, HIGH-POWER INFRARED LASER CHEMISTRY IN THE GAS PHASE

E. GRUNWALD, Brandeis University, School of Arts & Sciences, *Waltham, Massachusetts* 02154 (MPS75-20058)

Explanatory experiments have shown that irradiation of binary gas mixtures with a high-power pulsed tunable carbon dioxide laser is potentially a convenient and practical method for inducing specific chemical reactions on a macroscopic scale. In these experiments, the laser power was about one megawatt per square centimeter, the partial pressure of each gas about sixty torr, and the laser was tuned to a very strong absorption band. Several photons were absorbed per molecule, the absorbed energy being introduced into a specific vibrational mode of the absorbing species. The activated molecules, on reacting, in several instances showed some memory of the mode into which the energy was originally introduced.

The potential of high-power infrared lasers as energy sources for practical chemistry is now being studied in detail, using an essentially empirical approach with a sensitivity to theoretical implications. Rules for predicting which molecules can be activated in this way, the experimental details of typical or key reactions, the isolation and identification of reaction products, the rate laws and reaction mechanisms, and the photophysical mechanisms are being determined.

SUPPORTED BY U.S. Natl. Science Foundation

3.0009, DEVELOPMENT OF ALUMINUM/GRAPHITE COMPOSITE FOR AIRCRAFT

A.P. LEVITT, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0D4717)

The objectives of this work unit are: 1) to develop advanced, high- strength, lightweight aluminum/graphite fiber composites for structural applications in Army aircraft and missiles. Specific applications include beams, frames, stiffeners, skins, and panels for helicopters and missiles; 2) to evaluate the fatigue, fracture, stress-corrosion, and strength properties of aluminum/graphite fiber composites as a function of fiber orientation. Strength and crack-growth resistance both parallel and perpendicular to fiber orientation require study to determine failure modes and soundness of the fiber/matrix bond. The program thrust is survivability.

The approach for the first objective includes the fabrication of infiltrated TOWs produced by AMMRC and by commercial sources into aluminum/graphite specimens by solid and solid- plus liquid-phase bonding under a range of temperatures and pressure to determine the optimum fabrication methods. Infiltration of low-cost discontinuous graphite fiber mats by molten Al will also be investigated. The approach for the second objective is to evaluate the Al/G structures produced above for their tensile properties, fracture toughness, fatigue behavior, and stress-corrosion susceptibility. Properties will be determined for both transverse and longutidinal orientations for unidirectional fiber reinforcement. Failure modes as a function of orientation and processing will be characterized.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Research Center, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0010, IMPACT PROPERTIES OF GRAPHITE FIBER REINFORCED COMPOSITE MATERIALS
J.R. PLUMER, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0E4748)

To quantify the effects of low-velocity impact and foreign object damage on graphite fiber reinforced composite materials. To generate possible solutions to the problem of low impact strength of these composites. The HLH ATC program shows that, in certain applications, these composites have poor impact resistance and foreign object damage tolerance. This project is responsive to the major RDT & E program thrust No. 4.A, aircraft survivability, and to the pacing materials problem area, vulnerability and survivability of rotor blade components.

Testing of composite samples will be continued. The amount of energy necessary to cause damage, the energy absorbed by the sample, and the type and propagation mode of the failure will be determined. These data will be correlated with the fiber strength, fiber modulus, fiber surface treatment, resin type, and sample construction. The results of these correlations will be used to indicate possible solutions for the problem. Possible modifications to be investigated include: the incorporation of other materials such as Kevlar-49, fiberglass and graphite film; incorporation of rubber particles in the resin; changing the resin; and varying the structure of the composite panel.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Materials & Mechanics Research Center, Watertown, Mass. 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0011, CHARACTERIZATION OF BORON AND TITANIUM COMPOUNDS
K. TAUER, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0B4817)

To determine the parameters and mechanisms of conduction (electrical and thermal) of boron and titanium compounds, particularly titanium borides. These materials have unique conduction and thermophysical properties which determine their thermal shock properties and in particular their hardness to high-energy laser irradiation. Their excellent conductivities along with the probability that these properties can be tailored, e.g., as to the ratio of electric to thermal conductivities, offers good probability their resistance to high-energy laser irradiation can be maximized. Evaluation of these compounds as high-energy laser mirrors is similarly an objective of this program as well as deriving the thermophysical properties of compounds such as TiNi for use as associated damping materials.

The thermal and electrical conductivities in the temperature range 500-2000 degrees C (and higher, approaching the melting temperature of the samples) are derived by solving the differential equation relating heat generation, radiation and flow in a rod-like sample. The steady- state temperature is achieved by the heating of a known current and the measured temperature profile of the sample determines the derived values of thermal conductivity, emissivity, and Thomson coefficient. The specific heat is available from the transient temperature behavior of the sample. The primary experimental difficulties in the methold are: a) the accurate measurement of these high temperatures, and b) accurate sample geometries, particularly for high-hardness materials such as TiB sub 2.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AMC Materials & Mechanics Res. Ctr., Watertown, Mass. 2172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0012, SHAFT SEALS, GAS- AND CRYOGENIC-FLUID LUBRICATED
L.P. LUDWIG, U.S. Natl. Aero. & Space Adm., Lewis Research Center, *Cleveland, Ohio* 44135 (RTOP: 505-04-41)

DESCRIPTION: The general objective of this work was to demonstrate the feasibility of operating self-acting gas film seals at advanced conditions: 500 psi, 500 ft/sec and 1200 degrees F. Current face contacting seals are now operating at their maximum of 150 psi, 375 ft/sec, 1100 degrees F, with a very short life. Development of labyrinth seal systems for these extreme environmental conditions leads to added weight as well as excessive gas losses that greatly affect the efficiency and economy of operation, thus making it prohibitive. Further development of the self-acting seal concept would be of interest in the development of industrial gas compressors used in pipe lines and refineries. This seal also has the potential of acting as a buffer gas seal in the IMFBR as well as a helium seal for the helium GCRF reactor. Design tools were developed for this seal concept and are readily available. A further objective is to design a face-type shaft seal to operate in liquid oxygen at high speeds. Long life and low friction coefficient (to reduce heat supplied to LOX) are necessary for applications such as space shuttle or space tug. The approach is to use a non-contacting face seal that utilizes shrouded Rayleigh step pads to augment the lift-off, thereby reducing heat generated, and significantly improving the life of the seal. Problems to be investigated are: (1) effect of two-phase flow; (2) high pressure differentials (450 psi delta P); and (3) the effect of high rotative speeds (28,000 rpm). Also to be investigated are circumferential-type shaft seals for the same conditions (28,000 rpm at up to 450 psi).

SUPPORTED BY U.S. Dept. of Defense - Army

3.0013, PLASTIC FLOW AND FRACTURE CHARACTERISTICS OF HIGH-STRENGTH ALUMINUM ALLOYS
C. CARMAN, U.S. Army, Pitman Dunn Laboratory, *Philadelphia, Pennsylvania* 19137 (DA0B0455)

To characterize the plastic flow, fatigue, and fracture resistance of new high-strength aluminum alloys under static and dynamic loading conditions. This supports pacing materials problems of lightweight materials for munitions, aircraft and missiles. To attain optimum utilization of these new alloys in these mission areas, their toughness, fatigue resistance, stress corrosion characteristics, and dynamic response will be studied as a function of material purity and thermal mechanical treatment.

Fracture toughness, fatigue crack propagation, and corrosion- assisted crack propagation are being determined using linear elastic fracture mechanics. Commercial and high-purity/strength aluminum alloys are being studied in both the final thermal mechanical treated condition (FTMT) and the intermediate thermal mechanical treated condition (ITMT). Material dynamic response will be evaluated using a special high-rate hydraulic testing machine. The fatigue crack propagation studies will be conducted on a new high-speed fatigue machine. Emphasis will be placed on crack initiation and the threshold value of delta K.

SUPPORTING AGENCY ADDRESS INFORMATION: ARMCOM Pitman-Dunn Laboratory, Frankford Arsenal, Philadelphia, Pa. 19137

SUPPORTED BY U.S. Dept. of Defense - Army

3.0014, RESEARCH IN NUCLEAR CHEMISTRY
M. KAPLAN, Carnegie Mellon University, Mellon Institute of Science, *Pittsburgh, Pennsylvania* 15213 (E(11-1)3246)

Nuclear reactions induced by energetic heavy-ion beams of 160, 20Ne, and 40Ar in medium mass targets are being investigated using semi- conductor counter telescopes and recoil activation techniques. The angular correlations of nuclear cascade gamma rays will be measured to study the properties of the intermediate nuclear states and the perturbations produced by interactions with the surroundings.

RESULTS: Preliminary data have been obtained on the energies and angular distributions of evaporation residues from complete fusion reactions. Strong electric quadrupole interactions have been observed in several compounds by means of perturbed angular correlation measurements in Ta 181.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

3.0015, AN INVESTIGATION OF ELECTRON TRAPPING SITES IN BINARY GLASSES AND THEIR RELATION TO ELECTRICAL DISCHARGE IN GLASSES
D.L. KINSER, Vanderbilt University, School of Engineering, *Nashville, Tennessee* 37203 (DMR74-24613)

This proposal is concerned with elucidating the nature of electron trapping and the relationship of the charge storage to

catastrophic electrical discharge in some oxide glasses. Data presently available suggest that trapping sites may be associated with interfaces in micro- heterogenous glasses. Investigations will be conducted upon heterogenous glass systems including PbO-SiO2 and others which will be characterized using quantitative electron microscopy techniques. The atomic structure of the trapping site will be examined using optical, magnetic and dielectric measurement techniques. The relationships of microstructure to dielectric breakdown and charge storage will be determined. The results of this work should be useful in controlling radiation-induced storage or catastrophic discharge in numerous employed in radiation fields. These results may also contribute to the direct conversion of radiant energy to electrical energy.

SUPPORTED BY U.S. Natl. Science Foundation

3.0016, A PRECISION DILATOMETER STUDY OF QUENCHED METALS AND ALLOYS
P. WILKES, Univ. of Wisconsin, Graduate School, *Madison, Wisconsin* 53706 (DMR76-04730)

This is a basic study of select quenched metals and alloys, using an ultrahigh-sensitivity capacitance micrometer, capable of detecting length change as less than A degrees. This technique will be used to determine the vacancy volumes for nickel where the enthalpy (Ef) and vibratational entropy (Sf) for vacancy formation are known. It will also be used to determine Ef and Sf for aluminum, gold, silver and copper, for which the vacancy volume is known. In the latter case, the volume change for divacancy formation will be determined. Lastly, the effect of solute atom additions on Ef and Sf will be determined for dilute alloys of atoms with different diameters and/or valencies from the matrix.

SUPPORTED BY U.S. Natl. Science Foundation

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, RESEARCH STUDY ON FIBER OPTICS FOR NAVAL APPLICATIONS
R.F. POTTER, Unknown Inst. or Indiv. Grant, *California* (DN590166; N00019-76-C-0461)

The contractor shall perform a research study of the state-of-the- art of technology for fiber optics for naval applications.

Special emphasis will be placed on those aspects of fiber optics technology which pertain to aircraft internal communications and to underwater cable applications.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Naval Air Systems Command, Washington, D. C. 20360

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0002, GAS LASER PARAMETER ANALYSIS FOR HIGH-GAIN TRANSITIONS
H. GAMO, Univ. of California, School of Engineering, *Irvine, California* 92664 (ENG75-03226)

Several important parameters of high-gain laser transitions will be studied both experimentally and theoretically with emphasis on various line-broadening mechanisms and saturation behavior, especially under the high-intensity radiation. High-gain transitions in infrared region such as xenon 3.5 m and CO2 10.6 m will be studied by means of experimental techniques such as saturated gain analysis, spectral line-narrowing, pulse-duration and -delay analysis as well as statistical analysis of intensity fluctuations. These techniques have been developed and will be improved by utilizing digital signal processing. Study of high-gain laser transitions in shorter wavelength region such as those in metal vapor, inert gas or molecular lasers will also be initiated. The noise and saturation in photodetectors, which determine accuracy and systematic errors in laser parameter analysis, will also be studied by using th[illegible]igital processing.

SUPPORTED BY U.S. Natl. Science Foundation

4.0003, AN EXPLORATORY STUDY OF METAL VAPOR LASERS OPERATING IN THE ULTRAVIOLET AT KILOWATT POWER LEVELS
G.J. COLLINS, Colorado State University, School of Engineering, *Fort Collins, Colorado* 80521 (E(11-1)-2723)

We propose to demonstrate the feasibility of obtaining cw and pulsed laser action in the spectral region between 2000 and 4500 A from He-Au and He-Ag mixtures. We will purposefully emphasize cw laser transitions in the ultraviolet but retain strong interest in pulsed sources.

Our preliminary approach will be to obtain quasi-cw oscillation (200 microns duration) in the singly-ionized spectrum of two metal vapors (Ag and Au) excited in a hollow cathode discharge. Subsequently, true cw oscillation will be achieved. Rare gas-metal vapor mixtures will be employed (He-Ne-Au and He-Ne-Ag). All of the proposed laser transitions will rely on thermal-energy charge-exchange as the primary pumping mechanism, in order to insure that the laser system has a practical overall efficiency. Thermal-energy charge-exchange cross sections have been measured by the author to be greater than 10 to the minus 14th power cm squared in He-Hg discharges during the previous ERDA contract period.

Finally, we will measure the cross sections of the dominant excitation mechanisms in the Cu II laser. Cu II supports the shortest cw laser transitions obtained to date. Two cross sections, sigma (Ne plus minus Cu) and sigma (HeM minus cu) will be measured. In this way the scaling laws for the Cu II laser will be calculable.

In summary, a balanced program of applied and fundamental research is proposed with the goal of new laser systems operating in the ultraviolet spectral region at power levels of one to ten watts and efficiencies of 1%.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - L.F.D.

4.0004, IONOSPHERIC DYNAMICS BY INCOHERENT SCATTER
S.A. BOWHILL, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (ATM75-15523 A01)

This grant, a renewal of National Science Foundation Grant ATM- 7515523, funds continued studies of the Earth's atmosphere and ionosphere using data taken by incoherent scatter radar at the National Astronomy and Ionosphere Center in Arecibo, Puerto Rico, and at the Jicamarca Radio Observatory in Jicamarca, Peru.

In particular, it funds: 1) reduction and analysis of data previously taken at Jicamarca to study mesospheric gravity waves and tides, and mesospheric turbulence; 2) an experimental and theoretical investigation of sporadic-E at Arecibo. (Sporadic-E is the occasional intense concentration of ionization into a thin layer around 100km.) 3) studies of thermal conduction in the ionosphere above 500 km; 4) studies of unexplained radar echoes in the 140-170 km region.

SUPPORTED BY U.S. Natl. Science Foundation

4.0005, FREQUENCY TUNABLE LASER SOURCES
P.D. COLEMAN, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DF000190; AF-AFOSR-1981-71)

Improvements in the operation of Air Force communication and surveillance equipment are brought about by advances in electrooptical techniques and electromagnetic devices. Research on far-infrared optical electronics and tunable lasers in this region will contribute important results for the use of this part of the electromagnetic spectrum in communications, optical radars and diagnostic techniques. Scientific interests in this area include the use of the radiation for spectroscopy, resonance studies, plasma diagnostics, nonlinear optics and quantum electronics. The specific aims are to use the linear and nonlinear properties of IR and far-IR materials to generate (1) broadband frequency tunable signals at high power with modest linewidth and low power with narrow linewidth, and (2) to develop integrated optics, dielectric film waveguide circuits for this spectral region. Swept frequency sources are very important tools in any spectral range in developing and testing components, devices and systems and in studying sharp resonances and fine structure. Low-cost, rugged, efficient circuits that can be arranged to have a large packing density are a necessity if new complicated functions are to be performed.

SUPPORTING AGENCY ADDRESS INFORMATION: AF Office of Scientific Research NPP, 1400 Wilson Blvd., Arlington, Va. 22209

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0006, OPTICAL PROPERTIES OF MATERIALS AND COMPONENTS FOR OPTICAL COMMUNICATIONS
B. BENDOW, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF901050)

AF function - communications, command and control. Deficiency - lack of sufficiently detailed knowledge of properties of potential materials and components necessary for high-performance optical communications. Objective - to investigate, both experimentally and theoretically, the mechanisms influencing propagation of light in materials and components for current and contemplated optical applications in the Air Force, including laser and fiber optic communication systems.

Special emphasis will be given to characterizing losses and refractive properties of optical modulator materials such as gallium arsenide and cadmium telluride, of lenses and windows in the optical train of communication systems, of reflective and protective coatings, of integrated optic films and substrates (such as gallium arsenide and its alloys), and of optical fiber links. The influence of impurities, imperfections, and surface and interface effects on the properties mentioned will be evaluated.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0007, SOURCES WAVEGUIDES AND COUPLERS FOR THIN FILM OPTICAL CIRCUITS
R. PAYNE, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF900900)

AF function - communications. Deficiency or opportunity - current communications systems are to electromagnetic interference and have inadequate signal bandwidth. Objective - to develop new components for use in integrated optical circuits. How research contributes - by addressing the major technological problems in integrated optics.

Approach involves fabrication of gallium arsenide thin-film laser diodes with periodic gain and index-of-refraction variations, using photo-lithography and ion implantation techniques. Device evaluation will involve measurement of threshold characteristics and spectral response. Light-emitting diode (LED) and laser diode sources will be fabricated from InGaAs and InAsP grown by vapor-phase epitaxy. Methods for generating two-dimensional waveguide structures and integration of waveguides with active elements will be examined using electron beam resist and ion implantation techniques. Routine laboratory techniques for measurement of waveguide transmission losses, guided wave mode profiles and other relevant parameters will be established. Conceptual studies of tapered-film, grating and other methods of coupling sources, waveguides and detectors will be conducted.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0008, NONPOTENTIAL AERODYNAMICS FOR THE ANALYSIS OF WIND EFFECTS ON BUILDINGS AND STRUCTURES
L. MORINO, Boston University, School of Engineering, *Boston, Massachusetts* 02215 (ENG74-24729)

A general theory of potential flow past bluff bodies will be developed using the integral equation method. The wake from these bodies will be treated as a layer of vortices and is a natural byproduct of this method. Boundary conditions are satisfied using the proper Green's function. Numerical results will be obtained using the finite- element computations where the integral equation is reduced to a system of algebraic equations. This technique is very efficient and flexible, and both steady and unsteady problems can be examined.

SUPPORTED BY U.S. Natl. Science Foundation

4.0009, ANALYSIS AND TEST OF BEVERAGE ANTENNAS
R.W. KING, Harvard University, School of Engineering, *Cambridge, Massachusetts* 02138 (DF901650; F19628-76-C-0057)

AF function - aerospace antenna systems. Deficiency - arrays of beverage antennas are not sufficiently characterized at present to permit their full use over varying ground conditions in radar detection systems. How research contributes - provides an analysis tool in the form of an experimentally verified antenna current distribution as a function of element spacing, element height and ground constants.

The effort involves modeling the earth environment beneath beverage antennas, scaling frequencies of operation and under closely supervised laboratory conditions, measuring antenna current, driving point impedance, gain and efficiency as the model antenna is varied in height above the surface and the ground constants are varied to simulate a variety of real earth conditions. The measurements are used to validate a current expression that can be used under most ground and height conditions.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0010, SPECIALIZED RESEARCH EQUIPMENT - CATHODE RAY TUBE SCANNER FOR REAL-TIME CONTINUOUS OPTICAL SIGNAL PROCESSING
F.T. YU, Wayne State University, School of Engineering, *Detroit, Michigan* 48202 (ENG76-00836)

The acquisition of a cathode ray tube scanner will expand the current facility in coherent optics to permit experimentations in the continuous real-time optical signal processing of time signals. This capacity will be used to synthesize an optical speed spectrograph and will also be employed in current research projects involving optical detection of brain signals, in the reduction of data in remote sensing systems and in noise analysis.

SUPPORTED BY U.S. Natl. Science Foundation

4.0011, STUDIES IN HYDRODYNAMIC STABILITY
D.D. JOSEPH, Univ. of Minnesota, School of Engineering, *Minneapolis, Minnesota* 55414 (ENG75-19047)

This is a continuation of research previously supported under Grant GK-12500. A collection of fundamental problems in hydrodynamic stability will be examined. These are: 1) A global extension of Hopf's bifurcation theorem, the recovery of stability on subcritical bifurcating branches. 2. Free surface flows over porous media. 3) Wave number selection through stability. 4) Time-periodic solutions which bifurcate from the rest state of a simple fluid. 5) Bifurcation theory for nearly parallel flows.

SUPPORTED BY U.S. Natl. Science Foundation

4.0012, AVIONIC SUBSYSTEM INPUT/OUTPUT ANALYSIS
M. FISHER, U.S. Army, Avionics Laboratory, *Red Bank, New Jersey* 07703 (DA0D2823)

The objective of this subtask is to develop avionic subsystem interface characteristics (both operational sequences and electrical interconnections) for the Army digital modular avionics program.

Once the core system hardware has been selected, data and manuals will be collected from which the operating sequences and other pertinent information (physical characteristics, block diagrams, electrical characteristics) may be determined. Upon completion of the foregoing, similar analyses will be performed on other avionics equipments.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: ECOM Avionics Laboratory, Ft. Monmouth, N.J. 07703

SUPPORTED BY U.S. Dept. of Defense - Army

4.0013, SPIN FLIP RAMAN LASER STUDIES
G.J. WOLGA, Cornell University, Lab. of Plasma Studies, *Ithaca, New York* 14850 (E(11-1)-2848)

For optimum utilization of the SFRL for spectroscopy the frequency stability of the laser should be high, and the frequency should be smoothly tunable and controllable over useful ranges. These desired properties are not readily obtained with conventional laser designs. Discontinuous jumps in the operating frequency are observed as the gain profile is magnetically tuned across the static mode spectrum. The tuning rate over small tuning intervals is a complicated function of the operating parameters. The objectives of this project are to design a SFRL with a tunable and controllable cavity mode spectrum that can track the tunable gain profile and to decrease the internal laser resonator losses significantly so that new scattering processes and materials may be studied. The guiding principle in this project is to design, operate and study the properties of a SFRL in which an antiresonant ring interferometer encloses the lasing material and forms the end mirror for the pump laser resonator. The ring resonator will be implemented and operated with InSb as the lasing material and a CO laser pump. The tunable laser resonator modes will be synchronized with the tuning gain medium to enhance continuous tunability of the laser. Frequency stabilization of the tunable laser will be studied and laser stability will be measured. New materials and scattering processes will be studied with the goal of extending the wavelength region of tunable operation. The operating laser system will be employed in saturation spectroscopy studies of gases.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - L.F.D.

4.0014, POWER GENERATION TECHNOLOGY
UNKNOWN, U.S. Air Force, Aero Propulsion Lab., *Dayton, Ohio* 45433 (AF-PE 62203, PROJ. 3145)

DESCRIPTION: This project encompasses space and non-space efforts in solar power fuel cells, batteries, magnetohydrodynamics and power conversion, conditioning, and transmission. These analytical and experimental efforts form a balanced, broad base in power subsystem technology responsive to anticipated needs of aeronautical, missle, space, and electronic systems including ground power needs. General goals of these efforts are increased power output, decreased weight and volume, decreased vulnerability, increased life and reliability, increased tolerance to environments, and provision of effective options in technology and capabilities for future systems applications in the conceptual stage. Efforts during FY-75 will involve advanced solar cell concepts such as lithium doped silicone cells and vertical multi- junction silicon cells (which offer reduced cost per watt produced), increased life of regeneration fuel cells, high-energy-density rechargeable lithium batteries for space applications which have minimum weight, advanced battery configurations for electronic countermeasures (ECM) devices, sealed lead-acid batteries for aircraft that are virtually maintenance free, advanced auxiliary power units (APU), low- cost heat starters for aircraft, and dynamic analysis of advanced aircraft hydraulic systems which will permit the design of more reliable systems that have minimum weight.

ADDENDA: Estimated calendar year funding reported as 1975 $4,000,000.

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0015, AVIONICS SYSTEMS
R.P. RHOTEN, Okla. St. Univ., School of Engineering, *Stillwater, Oklahoma* 74074

This study is concerned with evaluating modern control and computation techniques with respect to applications in avionics systems design.

SUPPORTED BY Oklahoma State Government - Oklahoma City

4.0016, FLUID STATIC MAGNETIC TRANSDUCER
E.L. HIXON, Univ. of Texas, School of Engineering, *Austin, Texas* 78712

DESCRIPTION: When a conducting fluid flows transversely to a static magnetic field, a potential proportional to flow velocity appears across the fluid. Also, when a current is passed through the fluid in the presence of the magnetic field, a force is exerted on the fluid. The usefulness of this effect as an acoustic transducer is being investigated with particular attention to efficiency and frequency of response.

A device has been analyzed in terms of three-port parameters which involve the physical dimensions, fluid conductivity and static magnetic field. The mathematical model reduces to the well-known static device at zero frequency. The device has been built and the three-port transducer parameters have been measured. The analytical model proved adequate to predict these parameters over the frequency range of 100 Hz to 4 Hz.

SUPPORTED BY University of Texas

4.0017, MICROWAVE LANDING SYSTEM
A.H. LAGRONE, Univ. of Texas, School of Engineering, *Austin, Texas* 78712

DESCRIPTION: The problems of an Instrument Landing System (ILS) which depends on a ground-reflected wave can largely be circumvented by a microwave landing system which, because of its high frequency, uses antennas to form a glide path independent of the ground. The problems of a Doppler system operating in the microwave frequency range is being studied.

SUPPORTED BY University of Texas

4.0018, RADIATION PATTERN STUDIES OF INJECTION LASERS
J.K. BUTLER, Southern Methodist University, School of Engineering, *Dallas, Texas* 75222 (ENG74-22946)

This program of research is aimed at improving semiconductor radiation. Three principal topics associated with semiconductor laser operation that will be considered are: (1) radiation patterns, (2) radiation field polarization, and (3) lasers operating at currents well above threshold. Radiation patterns produced by devices operating with a mixture of modes will be investigated. To produce devices radiating maximum power, emphasis will be placed on lasers which will produce prescribed radiation patterns while working at currents well above threshold. Polarization studies of the field at the laser facet will be made. This research will be useful in coupling light energy from the source to the optical waveguide.

SUPPORTED BY U.S. Natl. Science Foundation

4.0019, INVESTIGATION OF LOW-COST SOLAR CELLS BASED ON CUPROUS OXIDE
L.C. OLSEN, Univ. of Washington, Joint Center For Graduate Stu., *Richland, Washington* 99352 (AER75-20501 A01)

This project is a continuation of the research on the earlier grant (AER 75-23453) to investigate the photovoltaic properties of thin-film solar cells based on cuprous oxide, particularly with respect to their potential as a low-cost solar cell. Specific objectives for the two- year effort are: (1) to demonstrate greater than 4 per cent power conversion efficiency for an AM 1 solar spectrum with improved Cu/Cu2O backwall solar cells; (2) to fabricate and evaluate heterojunction Cu2O solar cells, and (3) to establish Cu2O doping approaches to improve minority carrier properties.

SUPPORTED BY U.S. Natl. Science Foundation

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, PHOTODISSOCIATION CROSS SECTIONS AND SPECTROSCOPY OF ATMOSPHERIC IONS 13635-PX
J.T. MOSELEY, Stanford Research Institute, *Menlo Park, California* 94025 (DA0E9019; DAAG29 76 C 0020)

To determine absolute photodissociation cross sections for positive ions important in the atmosphere and other ionized gases. To obtain information about the potential surfaces and structures of the ions, lifetimes of the excited states, and the partition of energy in the photodissociation process. This program is relevant

to the development of models of normal and disturbed atmospheres and directly supports the primary mission of the aeronomy branch of the Ballistic Research Laboratory. The information is ultimately used in developing predictions of atmospheric behavior, particularly as electromagnetic transmission is affected by nuclear weapon bursts.

Drift tube and fast beam apparatus combined with high-power tunable lasers will be used to determine the absolute photodissociation cross sections. Measurements will be made on those ions which now appear to be most important, in particular, No (plus).(H sub 2 O) sub N, H (plus).(H sub 2 O) sub N (N equals 1 minus 3), No (plus).Co sub 2, No (plus).N sub 2, No (plus).No, O sub 4 (plus) and O sub 2 (plus).H sub 2 O.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

5.0002, ANALYSIS OF SATELLITE DATA ON AURORAL HELIUM IONS

R.D. SHARP, Lockheed Aircraft Corporation, *Palo Alto, California* 94304 (DES74-21834)

This is a program for the analysis of data from the energetic ion mass spectrometer experiment on the satellite 1971-089A. The experiment measures ions in the energy range 0.7 to 13 keV per-unit-charge and separates the ionic components on the basis of mass-per-unit-charge. The central focus of the investigation will be the utilization of the helium-ion component of the auroral ion fluxes as test probes for the investigation of various magnetospheric processes which may be charge or mass dependent. To pursue this end, a study will be conducted of the morphology of the precipitating helium ions in the keV range and a comparison will be made primarily with precipitating auroral and ring current protons.

SUPPORTED BY U.S. Natl. Science Foundation

5.0003, NSF/NOAA INTERNATIONAL MAGNETOSPHERIC STUDIES IONOSONDE PROGRAM (IMSIP)

D.J. WILLIAMS, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (ATM75-23574 A01)

This award will complete the funding of the construction of a digital ionosonde (see National Science Foundation Grant ATM-7523574). Progress on the construction has been satisfactory and the fulfillment of this commitment will enable the ionosondes to be completed and deployed by mid 1977, in time for cooperative experiments during the International Magnetospheric Study (IMS).

SUPPORTED BY U.S. Natl. Science Foundation

5.0004, WATERSPOUT-TORNADO VORTEX THERMODYNAMICAL PROPERTIES DERIVED FROM IN-SITU AND REMOTE-SENSING MEASUREMENTS

P. SINCLAIR, Colorado State University, School of Engineering, *Fort Collins, Colorado* 80521 (B5686)

SCOPE: 1. Determine dynamical-thermodynamical properties across and within the boundaries of the waterspout funnels by direct probing by aircraft of the waterspout funnel, parent cloud, and immediate environment of the system. 2. Develop physically relevant analytical and numerical vortex models based on a synthesis of the field measurements. 3. Determine the similarities and relationships between the waterspout and the tornado systems.

SUPPORTED BY U.S. Nuclear Reg. Comm. - Washington, D.C.

5.0005, TURBULENCE AND AEROSOL INVESTIGATION IN THE POWER ATMOSPHERE

R. REITER, Physical Bioclimatic Res. Inst, *Garmisch Partenkirchen, Federal Republic of Germany* (DA0C9316; DAERO 75 G0077)

To investigate turbulence and aerosol behavior in the lower atmosphere.

To continue this study in the Garmisch Valley utilizing the expertise and laboratory and field instrumentation of Dr. Reiter and his laboratory staff.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Research & Standardization Group (Europe), Box 15, FPO, N.Y. 09510

SUPPORTED BY U.S. Dept. of Defense - Army

5.0006, ATMOSPHERIC SCIENCES - ATMOSPHERIC BOUNDARY LAYER INVESTIGATIONS

P. FRENZEN, Argonne National Laboratory, *Argonne, Illinois* 60439

DESCRIPTION: Assessments of regional environmental impacts of nuclear power installations and fuel reprocessing plants, as well as the development of atmospheric models to be used for such assessments, require an improved understanding of mesoscale atmospheric dispersal processes. In particular, there is need for additional information on the manner in which these circulations are affected by changing synoptic meteorological situations and varying terrain. This program uses acoustic remote-probing techniques to observe and record atmospheric conditions that affect the transport and diffusion of pollutants over mesoscale distances. Acoustic-sounder data recorded at several locations are being interpreted along with standard meteorological and air-quality measurements to quantify the effects of terrain variation and changing meteorological conditions on dispersion in the lower atmosphere. Results obtained will be used to develop improved methods for regional air-quality assessment.

ADDENDA: Estimated calendar year funding reported as 1975 $244,000.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - B.E.R.D.

5.0007, COUNTY ENGINEERING SOILS MAPPING

P.T. YEH, Purdue University, Joint Highway Research Project, *Lafayette, Indiana* 47907 (108637 (HRB NO.))

An engineering soils map is being made of the individual counties as well as of the State of Indiana. Engineering soils maps with a report are prepared of individual counties at a scale of one inch equals one mile using aerial photographs and agricultural soil survey field sheets as basic sources of soil information. Soils are sampled in the field by the soil conservation service and engineering soil tests are performed. Fifty-eight counties have been completely mapped and copies are available.

ADDENDA: Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY Indiana State Government - Indianapolis

5.0008, A STUDY OF THE DYNAMICS OF NON-SPHERICAL ATMOSPHERIC PARTICLES

I. GALLILY, Hebrew University of Jerusalem, *Jerusalem, Israel* (DA0B9429; DAERO 76 G0014)

Study the deposition of non-spherical (solid) aerosols on, and the penetration through, objects and materials.

Laboratory experiment devoted to controlled generation of nonspherical (solid) aerosols and development of methods for their size, concentration and electric charge measurements. Relevant to: cloud and fog modification; communications; laser charge transmission; Army aviation; and pollution control.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army R & S Group (Europe), Box 65, FPO, N.Y. 09510

SUPPORTED BY U.S. Dept. of Defense - Army

5.0009, MICROWAVE SENSING OF SEA SURFACE TEMPERATURE AND WIND SPEED FROM SEASAT

R.A. PORTER, Radiometric Technology Inc., *Wakefield, Massachusetts* 01880 (7-133; 6-35217 MOD. NO. 1)

OBJECTIVE: To provide the formulae and mathematical procedures whereby radiances of the surface of the sea, as observed by a Scanning Multichannel Microwave Radiometer (SMMR) aboard the SEASAT spacecraft, can be interpreted to provide measurements of sea surface temperature and wind speed.

APPROACH: Refine mathematical-empirical model that will reveal the capability of the SEASAT SMMR to measure sea surface temperature and wind speed through varying degrees of atmospheric radiation, solar radiation and radiometer noise.

CURRENT PLANS: Incorporate results from all SEASAT microwave frequencies (SMMR) into an algorithm development that models atmospheric radiation foam, salinity and white caps to insure a sea surface temperature and wind speed determination.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

5.0010, GRIZZLY BEAR HABITAT RESEARCH

J.J. CRAIGHEAD, Univ. of Montana, State Coop. Wildlife Res. Unit, *Missoula, Montana* 59801

The Endangered Species Act prohibits federal agencies from jeopardizing threatened or endangered species by disturbing or destroying critical habitat. Critical habitat for most species has not been defined or delineated. To define and analyze critical habitat for the grizzly bear (Ursus arctos horribilis) in the Lincoln-Scapegoat Wilderness, Montana, we combined conventional data-gathering techniques with electronic scanning and digital data recording from satellites. We employed a user-interactive computer (General Electric's IMAGE 100) and LANDSAT -1 imagery with quantitative sampling methods.

Using ground truth obtained within the Scapegoat study area, we extrapolated to an adjoining area of approximately 2,500 square miles.

During the summer of 1976, we propose to establish 300-400 ten-acre field test sites within the 2,500 square mile extrapolated area (exact number to be statistically determined). The field test sites will be visited and the vegetation on each site described and typed. These sites will enable us to check the accuracy of the extrapolation from the LANDSAT multispectral imagery.

ADDENDA: This project is also supported by: National Aeronautics and Space Administration.

SUPPORTED BY Natl. Geographic Soc. - Washington, D.C.

5.0011, NATURAL ATMOSPHERIC RADIOACTIVITY

M.H. WILKENING, New Mexico Inst. Min. & Tech., Graduate School, *Socorro, New Mexico* 87801 (DES75-13454)

Mountains and the convection process which they induce play an important role in the triggering of thunderstorms during the summer months in the semiarid regions of the Southwest. The details of the processes by which water vapor gets from low levels in the canyons and basins surrounding the mountain ridges into growing cumulus clouds are not well understood. It is the purpose of this study to use airborne recorders of temperature, humidity, and turbulence indicators and the naturally occurring radioactive gas, radon, to learn more about the nature of the vertical transport mechanism, whether by bubbles or plumes; the origin of the water vapor, whether from near the surface around the mountains or from horizontal flows at midmountain levels; and to estimate the inputs of moisture or natural radioactivity into the bases of cumulus clouds early in their development.

Techniques involving the measurement of radon daughter ion and total small ion concentrations which were used previously at ground level at Langmuir Laboratory will be used to study the relative importance of ion migration, attachment to aerosols, and recombination mechanisms near cloud base.

The research will involve measurements of electrical parameters including conductivity, small ion concentration, and potential gradient on sites where the radioactivity, condensation nuclei and thermodynamic properties of the atmosphere can be monitored. Comparisons with an atmosphere where similar ion pair production rates anticipated from reactor-produced krypton 85 will be made.

SUPPORTED BY U.S. Natl. Science Foundation

5.0012, INTERACTION BETWEEN THE PLANETARY BOUNDARY LAYER AND SYNOPTIC AND MESOSCALE CIRCULATIONS

L.J. MAHRT, Oregon State University, School of Science, *Corvallis, Oregon* 97331 (DES73-06540 A01)

The objective of this research is to investigate interactions between the planetary boundary layer (PBL) and free flow on synoptic and mesoscales of motion. A layer integrated model of the PBL will be used. This model employs existing similarity theory for the case of conditions approaching free convection. Extending the layer integrated-similarity approach to other conditions by analyzing existing aircraft data and numerical simulations will be considered.

In the case of steady flow with weak momentum and temperature advections, integral constraints for boundary layer defects have been derived to close the model. A simple baroclinic model in isentropic coordinates will be used to examine the response of the free flow to parameterized PBL vertical motions. Analyses of NHRE and SESAME data will be used to assist the development of the above models and to examine the PBL influence on initiation of moist convection.

SUPPORTED BY U.S. Natl. Science Foundation

5.0013, ENGINEERING SOIL SURVEY FROM AERIAL PHOTOGRAPHY

J.B. GARNER, Univ. of Leeds, *Leeds, England, United Kingdom* (086005 (HRB NO.))

Photographs taken at several different scales and at various times of the year are being employed. The suitability of the various scales and times of year for taking photographs for engineering soil identification is being investigated. The soils are being identified on the basis of the BSCS classification and the various soil boundaries recorded in coordinate form with the aid of the d-mac coordinate reader. This information is transformed to national grid coordinates using a projective transportation technique relative to selected ground control points. The paper tape output from the d-mac is thus used as a data tape for a computer program which ultimately plots the required soil maps automatically. /IRRD/IRF/

ADDENDA: Document provided to S.S.I.E. by the H.R.I.S.

SUPPORTED BY No Formal Support Reported

5.0014, CONTINUATION AND SUPPLEMENT OF CASE STUDIES EMPLOYING SATELLITE INDIRECT SOUNDINGS

L.H. HORN, Univ. of Wisconsin, School of Natural Sciences, *Madison, Wisconsin* 53706 (8-612; 04-4-158-2 MOD. NO. 5)

TECHNICAL OBJECTIVES: The principal objective of this research is to exploit characteristics of indirect temperature soundings which enable them to enhance conventional data sources in describing and predicting weather systems. Special emphasis is directed to severe or potentially severe weather where the high spatial density of satellite observations can fill in the scales below the resolution of the radiosonde network. Attention is also focused on using the satellite observations between regular 12-hourly radiosonde reporting times to increase temporal resolution in fast development situations.

APPROACH: A case study approach is used with data obtained from the Nimbus-5 and Nimbus-6 satellites. Objective analysis techniques are developed for use with satellite temperature data to demonstrate: a) the ability to define the vertical wind shear from satellite-derived temperatures; b) the vertical and horizontal resolution of temperature fields obtainable with current satellite data. The case studies with objective analysis methods are used for both application and evaluation of the satellite-derived data. Particular situations to be explored include: a) the fine structure within and around the jet streak in tornado/severe thunderstorm situations; b) the location of critical thickness contours in snow vs. rain conditions; c) the detailed evolution of intense cyclogenesis.

PROGRESS: Objective analysis systems have been developed and demonstrated with temperature data derived from Nimbus-5 data. The capability of defining the vertical and horizontal resolution of temperature and wind shear to at least the resolution necessary for initializing the National Meteorological Center Local Fine Mesh (LFM) forecast model has been demonstrated. The satellite data have been shown to be spatially somewhat more consistent than radiosonde data. Over the United States, the satellite data have been shown to provide very reasonable continuity in depicting a rapidly developing baroclinic weather system between radiosonde observation times.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

5.0015, STUDIES OF THE ATMOSPHERE USING AEROSPACE PROBES
V.E. SUOMI, Univ. of Wisconsin, Space Science & Engr. Center, *Madison, Wisconsin* 53706 (8-012; 04-6-158-44087)

OBJECTIVE: To study the mid-latitude mesoscale dynamic structure of severe weather systems (e.g., winds, convergence, moisture field, stability) and to provide rational explanations of the observations in physical principles; to identify those characteristics of the atmosphere which may distinguish severe from ordinary thunderstorms for forecasting purposes.

APPROACH: An archive of severe weather outbreaks over the U.S. will be assembled from 6- and 15-minute GOES satellite images, hourly surface observations, 12-hour soundings, and satellite temperature retrievals. From these data, a series of case studies will be made by examining the mesoscale dynamic structure of the severe storms. Common dynamic forcing mechanisms (e.g., convergence patterns, location and strengths of jetstreams) will be looked for using McIDAS, the image analysis facility.

Theoretical modeling studies will complement the observational studies by contributing to explaining the observations and planning and testing schemes for new observations.

PROGRESS: A 3-dimensional mass circulation field around a tropical cloud cluster was calculated for GATE studies; studies show that the full advantage of high resolution in GOES data is realized only with increased time resolution; motions in inertially unstable regions were modeled and the distinction between inertia instability and barotropic instability will be studied.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, MEDICAL RESEARCH APPLIED TO THE PROBLEMS IN ARMY AVIATION (03)
W.P. SCHANE, U.S. Army, Aviation Medicine Res. Div., *Ozark, Alabama* 36360 (DA0D6736)

To provide the US Army information about those variables found in Army aviation which influence the health of the aviator.

To apply accepted medical research methods in Army aviation to fulfill the above objective.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MD R & D Com., (Army), Aeromedical Res. Lab., Ft. Rucker, Al. 36360

SUPPORTED BY U.S. Dept. of Defense - Army

6.0002, HUMAN FACTORS ENGINEERING IN SUPPORT OF ARMY AVIATION
C.A. FRY, U.S. Army, Human Engineering Labs., *Aberdeen Proving Ground, Maryland* 21005 (DA0C4955)

To devise means of simplifying helicopter crewstation through effective control/display integration for enhancing mission performance in night, terrain flying operations. Establish human performance criteria for performing aircraft maintenance in the forward area under night conditions.

Design parameters will be established for optimizing the interaction of the aircrew with the helicopter through a process of analysis, mock-up simulation, and flight test. The major problems to be addressed are control/display arrangement in the cockpit, CRT integration, symbology parameters, navigational accuracy, communication simplification, target hand-off and aircraft control simplification. Maintenance tasks will be analyzed to ascertain potential for simplification and the value of tactile cues for night, forward area operations. A focal point of cockpit instrumentation will be established to insure sound integration of all equipment which interfaces with the crew.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Human Engineering Lab., Aberdeen, PG, Md. 21005

SUPPORTED BY U.S. Dept. of Defense - Army

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, ADAPTIVE APPROXIMATION TECHNIQUES IN OPTIMIZATION 11260-M
E. POLAK, Univ. of California, School of Engineering, *Berkeley, California* 94720 (DA0D9140; DAAG29 73 C 0025)

To develop high-quality adaptive implementations of optimization algorithms for the solution of problems in optimal control and mathematical programming. Optimization procedures have a wide range of applications to military problems such as missile trajectory corrections, resource allocation, control of physical processes, analysis of weapon system effectiveness. The proposed research in adaptive approximation technique may lead to increased accuracy and savings in computational costs in the solution of such problems.

To utilize, test and modify as necessary, a theory of adaptive implementation in the construction of highly efficient adaptive implementations for a number of recently introduced, highly promising optimization algorithms.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Rsch. Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

7.0002, QUALITATIVE PROPERTIES OF DIFFERENTIAL EQUATIONS 11655-M
H.A. ANTOSIEWICZ, Univ. of Southern California, School of Letters Arts & Sci., *Los Angeles, California* 90007 (DA0D9194; DAHC04-74-G-0013)

To conduct a qualitative study of differential equations and generalized boundary-value problems. Results of this research will be applicable to the design of control systems for use in missiles, automatic weapons, fire control and aircraft. Singular perturbation problems occur in various flow problems. This study will also enhance the understanding of problems relating to flow over projectiles, missiles, and other similar configurations.

Studies will include: (1) Existence theorems for differential relations and functional-analytic methods for generalized boundary-value problems for nonlinear ordinary differential equations; (2) Singular perturbation problems and the analytic theory of differential and difference equations; (3) Skew-product flows in topological dynamics and their applications to ordinary differential equations.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

7.0003, VIKING SOFTWARE DATA
G.A. HEYLIGER, Martin Marietta Corporation, *Denver, Colorado* 80201 (DF728290; F30602-76-C-0269)

The objective of this effort is to analyze the effect on software production caused by the introduction of formal management and programming practices on the Viking Mars Lander software.

The software production standards and practices used by the contractor will be collected and documented. The after-the-fact data (track record) of cost, quality and development problems will be gathered for the Viking project. The data will be analyzed to detect anomalies and obvious improvements in capability which can be correlated to the introduction of a particular tool, standard or set of practices. Data on the effectiveness of the software engineering practices will be discussed in the final report.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ISI, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

7.0004, MEAN FIELD VARIATIONS IN RANDOM MEDIA 12334-E
J.J. MCCOY, Catholic University of America, School of Engin. & Arch., *Washington, District of Columbia* 20017 (DA0D5570; DAAG29 76 G0084)

Development of a statistical theory of linear elastic solids that possess disordered substructures to determine effects of inclusion shape and positioning on the effective mechanical properties of composites. Relevance - composites for diverse Army applications such as helicopter blades, airframe components, body armor, etc., have yet to be designed optimally. This study will provide information which will greatly assist in such evaluations.

Shape and packing information is assumed, and using a computer simulation of the substructure geometry, statistical moments are calculated and interpreted.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Rsch. Office, P.O. Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

7.0005, DYNAMICS OF AIRCRAFT ACCIDENT VICTIMS - COMPUTER SIMULATION
R.R. MCMEEKIN, U.S. Dept. of Defense, Armed Forces Inst. of Path., *Washington, District of Columbia* 20305 (DA0B6608)

Computer simulation of the kinematics of occupants in selected aircraft accidents in order to recreate the sequences of injuries and to determine their specific cause(s). This will lead to an increased understanding of the pathogenesis of such injuries and lead to more effective means of preventing them. The results of this project will enable the Army to better understand aircraft injuries and allow it to better cope with same.

Operate the Calspan three-dimensional program model using selected aerospace pathology branch cases as input data. Correlate the actual injuries observed at autopsy with the occupant kinematics of the computer simulation.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: MDRDC Armed Forces, Institute of Pathology, Washington, D.C. 20306

SUPPORTED BY U.S. Dept. of Defense - Army

7.0006, ALGEBRAIC TESTS FOR FUNCTIONAL CONTROLLABILITY OF FUNCTIONAL DIFFERENTIAL EQUATION SYSTEMS
R. TRIGGIANI, Iowa State Univ. of Sc. & Tech, Univ. Press, *Ames, Iowa* 50010 (DF044060; AF-AFOSR-3038-76)

AF function - the flexibility available using digital computation has promoted the importance of the control system in determining overall system performance for modern Air Force systems. Deficiency - many of these systems have inherent time delays in their dynamics, and for these systems no methods exist in general for choosing an input so as to have the system track a desired output. Objective - the objective of this research is to determine under what conditions the above defined reproducibility problem can be approximately solved, forcing the output to be arbitrarily close to the prescribed function over a given interval. How work contributes - success here would provide more insight to the solution of an important class of Air Force problems.

The approach will be to reformulate the equation as an evolutionary equation in a suitable function space. This abstract operator characterization has already been shown by the author to be useful in treating partial differential equations (PDE's) and integral differential equations (IDE's) of Volterra type. Now a unified mathematical treatment will be obtained which is applicable to functional differential equations (FDE's) as well.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Office of Scientific Research NM, Bldg. 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

7.0007, STUDIES OF THE NUMERICAL SOLUTION OF ELLIPTIC PARABOLIC BOUNDARY-VALUE PROBLEMS
I. BABUSKA, Univ. of Maryland, School of Engineering, *College Park, Maryland* 20740 (E(40-1)-3443)

The proposed work relates to the theory of numerical solution of partial differential equations in the following three areas: A. Self- adaptive approach in the finite-element method and related topics. The main goal is the design, its theory, and the implementation of an approach when main parameters (related to required accuracy) will be selected by the computer itself. In practice and until now, these parameters (e.g., mesh sizes, step sizes, etc.) have been selected by experience. Many times such an approach is very unreliable and ineffective. B. Problems arising from composite materials. A successful solution has to be based on replacement of the microstructure by macrostructures with the bulk properties. Mathematically the problem leads to the differential equation with rapidly changing coefficients. These problems are of great importance in the areas of composite materials, polymers, etc. The goal is to develop a rigorous mathematical theory and the implementation of this approach called homogenization. C. The finite-element method approach to boundary-value problems of mixed type and related topics. The main objective is the reduction of the given problem to a positive symmetric first-order system with admissible boundary condition so that a variational formulation is possible without regard to the type of the equation. The analysis of convergence and error estimates for the resulting finite- element procedure will be carried out and application to elastic-plastic flow and other areas will be made.

RESULTS: The results in the proposed field have been obtained by the investigators and published in form of various reprints and publications.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

7.0008, DIFFERENTIABLE DYNAMICS AND HAMILTONIAN MECHANICS
K.R. MEYER, Univ. of Cincinnati, School of Arts & Sciences, *Cincinnati, Ohio* 45221 (MCS75-05862 A01)

This is a continuation of research previously supported under GP- 37620.

K. Meyer will continue his work on the qualitative theory of ordinary differential equations with special emphasis on Hamiltonian equations. Some applications to terrestrial and celestial mechanics are anticipated. He will extend his work on bifurcation of periodic solutions to equations which admit symmetries. The restricted three- body problem and Duffing's equation are examples of such equations. The geometry of symplectic manifolds plays an important part in the study of Hamiltonian systems. New progress has been made in the understanding of holonomic and non-holonomic systems. These results should help in the computations on the satellite problem of celestial mechanics. A generic study of solenoidal minimal sets in Hamiltonian systems will be made.

SUPPORTED BY U.S. Natl. Science Foundation

7.0009, HIGH-SPEED ROTOR BALANCING 12515-E
W.D. PILKEY, Univ. of Virginia, School of Engin. & Appl. Sci., *Charlottesville, Virginia* 22903 (DA0B5576; DAAG29 75 G0055)

To develop (1) mathematical programming techniques to optimize the balancing of rotors, and (2) optimize design of suspension systems for rotating shafts. Relevance - the Army is using heavy equipment, large shafts, and high-speed rotating systems. These require new and sensitive methods of balancing as well as improved methods of suspension. This proposal is addressed to just such needs.

The approach is mathematical, using programming techniques as well as statistical methods to investigate noise in the system and its relation to system sensitivity.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, THEORY OF ELEMENTARY PARTICLES
S. MANDELSTAM, Univ. of California, School of Letters & Science, *Berkeley, California* 94720 (PHY74-08175 A02)

Research will be carried out in a number of branches of particle theory. In dual models, it is hoped to apply to realistic models methods which have been developed for spontaneous symmetry breaking. It is planned to apply operator methods, already used in one-dimensional problems, to explore the relation between the dual string and the Nielsen-Olesen vortex, and to continue the work on quark confinement within this system. On the subject of gauge theories, an attempt is being made to eliminate the Higgs scalars in favor of a B.C.S. mechanism. The problem of pi-eta degeneracy is being studied further. It is also hoped to extend the models where electromagnetism appears as a consequence of strong interactions. Work will be continued on models of the psi meson which avoid difficulties of current models. Methods already proposed for treating the renormalization group, especially with regard to infrared problems, will be continued. With regard to the structure of von Neumann algebras, work already performed on the duality condition has led to problems which will be studied; possible implications for scattering theory may be interesting.

This work represents a continuation of that currently supported by Foundation grant PHY74-08175 AO1. Scientific summary same as for that grant.

SUPPORTED BY U.S. Natl. Science Foundation

8.0002, STUDIES OF NEUTRINO AND COSMIC-RAY INTERACTIONS
F. REINES, Univ. of California, School of Physical Sciences, *Irvine, California* 92664 (E(11-1)-GEN 10, 019)

This research is generally in the area of weak interactions, very low counting and cosmic rays. Under investigation is double beta decay using a cloud chamber, counter configuration. The isotopes being considered are Ca48 and Se82. Studies of the reaction antineutrino electron plus electron yields antineutrino electron plus electron and the associated antineutrino electron spectrum from fission continue as does work preparatory to a check of the charged and neutral current reactions: antineutrino electron plus d yields n plus p plus antineutrino.

A 7m3 liquid scintillation detector has been operated in a preliminary way to study backgrounds from cosmic rays and radioactivity in a salt mine 1900 feet below sea level.

Work is proceeding on an experiment to test for the absence of a small adventure of an advanced potential in an electromagnetic wave.

RESULTS: Backgrounds have been reduced in the nu electron plus electron yields nu electron plus electron yields nu electron plus electron detector which now sees a 3 standard deviation reactor associated signal at a level not incompatible with V - A prediction.

The double beta decay detector is now in operation with a Se82 source.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0003, STUDY OF ELEMENTARY PARTICLE INTERACTIONS
J. SCHULTZ, Univ. of California, School of Physical Sciences, *Irvine, California* 92664 (AT(04-3)-34,0149)

Several projects are proposed or in progress: 1. DELCO (SLAC Experiment SP-25), a proposed search for short-lived, weakly decaying particles by detection of prompt single electrons in multi-hadron events at SPEAR. 2. Completion of a study of neutral kaon L p interactions producing K*(890) using the SLAC 15' rapid cycling bubble chamber and leutral kaon spectrometer (SLAC Experiment E92). 3. Production of massive (greater than GeV/c2) muon pairs in neutral kaon minus nucleon interactions, using a copper target and the existing neutral kaon spectrometer at SLAC (SLAC Experiment E119) 4. Study of pd interactions below 1 GeV/c in the BNL 30' deuterium bubble chamber, with particular emphasis on the structure of the Dalitz plot for the three-pion state, and a study of the final states involving lambda zero's. 5. A proposed experiment to study final-state interactions and pion correlation coefficients in pp interactions at 1 GeV/c, using a track-sensitive target (TST) in the ANL 12-foot bubble chamber with neon added to detect multi-neutral pion final states. 6. Collaboration on a study of pd and positive pion interactions at 200 GeV/c in the NAL 30'-deuterium-filled bubble chamber to investigate multiplicity distributions and particle spectra.

RESULTS: There are no published results to date on any of the above projects.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0004, INFRARED LASER-PLASMA RESEARCH EQUIPMENT
F.F. CHEN, Univ. of California, School of Engin. & Appl. Sci., *Los Angeles, California* 90024 (ENG75-16610)

A CO2 laser amplifier will be purchased to provide increased power at infrared frequencies for plasma experiments. The amplifier will be utilized by a plasma physics program that is designed to study the basic physical mechanisms in the nonlinear interaction of intense laser radiation with plasmas. Heat conduction in magnetized plasmas, detection of transverse pondermotive force in underdense plasma, detection of stimulated Brillouin scattering, and observation of filamentation instabilities are among the research areas that will benefit from the equipment.

SUPPORTED BY U.S. Natl. Science Foundation

8.0005, STUDIES IN PARTICLE PHYSICS
R.P. HADDOCK, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (E(11-1)-GEN,10,025)

The objective of the program is research in particle physics by means of experiments that are conceived, staged, and analyzed at UCLA but carried out at National Laboratories. The proposed research projects are investigations in elementary particle physics in medium energy. The following subjects are studied: (a) Pion-nucleon and nucleon-nucleon interactions; (b) Invariance principles and selection rules; (c) Electromagnetic and weak interactions of hadrons. Specifically, we propose to investigate the following processes: 1) pi plus T yields gamma He3 and pi minus He3 yields gamma T, to study time- reversal invariance in the electromagnetic interaction of hadrons via a comparison with the inverse reactions. 2) pi plus T yields pi o He3, pi minus T yields pi o T yields pi plus T and pi plus or minus He3 yields pi plus or minus He3 to study isospin invariance by testing the triangle inequalities and isospin breaking by comparison of various rates; furthermore, to test specific calculations of pion interactions involving isobaric analog transitions in complex nuclei. 3) pi plus or minus p yields pi plus or minus p gamma, to test the validity of the soft photon approximation (SPA), external emission dominance (EED), and to investigate specific proposals to determine the magnetic dipole moment of the (1232) resonance. 4) pp yields pp gamma, to test recent ideas on hadron-hadron bremsstrahlung at incident energies substantially above the threshold for pion photoproduction, specifically, the validity of SPA and EED; furthermore to study (pp) off-mass shell amplitudes.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0006, THE SUPERFLUID PROPERTIES OF LIQUID HELIUM
I. RUDNICK, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (DMR76-22306)

Under NSF Grant DMR74-20823 simultaneous measurements were made of the velocity of first, second and fourth sound in superfluid Helium4 using an array of mechanical resonators. Supplementing these data with published data on the expansion coefficient and the entropy at one point, the complete thermodynamics of Helium4 were obtained from 1.2K to T and from vapor pressure to the melting curve. These measurements will be extended down to about 0.4K. Additional experiments to be undertaken with the array of resonators are: (a) a continuing study of the healing length of superfluid as a function of P and T; (b) a study of the Helium3 excitation spectrum in Helium3-Helium4 mixtures and (c) an investigation of the nature of sound propagation in the resonators when the helium is solid. Second sound in superfluid Helium3 has never been observed. Attempts will be made to detect it and measure its velocity using a spherical resonator and a frequency of approximately 3 cps. The fountain

pressure in Helium3 will be sought and if found will be used to measure the entropy. For He II in a rotating, cylindrically symmetric vessel, the vortex distribution in equilibrium is not axially symmetric. The model of a rotating, weakly interacting Bose gas will be studied in order to understand how these rotational quantum-phase transitions occur. Additionally, the elastic theory of the recently speculated supersolids will be investigated, especially to understand if and how irrotationality can be consistent with a crystal structure. Although experiments have shown that the 1/f noise is an equilibrium phenomenon, there is as yet no theoretical explanation consistent with the laws of thermodynamics. Various models will be investigated within the general framework of the theory of stationary, Gaussian, Markovian processes.

SUPPORTED BY U.S. Natl. Science Foundation

8.0007, RESEARCH IN HIGH-ENERGY PHYSICS
D.H. STORK, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (E(11-1)-GEN-10, 017)

Four experiments in high-energy physics are in progress. (1) A bubble chamber study of baryon exchange has been run at SLAC with a 12 GeV/c negative pion beam through the 40-inch rapid cycling liquid- hydrogen bubble chamber followed by a neutron calorimeter. Bubble- chamber and spark-chamber photographs are being measured on MOLLY at our Southern California Film Measuring Center. (2) A pion form factor experiment (E216) has been run at FNAL with a 100 GeV/c negative pion beam through a liquid hydrogen target with a narrow-angle spectrometer. Data tapes from our online HP computer are being processed to determine the elastic pion-electron scattering cross section and hence the pion radius. Plans are under way to run at higher energies with kaons as well as pions. (3) A study of inclusive antinucleon production in positron-electron collisions will be carried out at SPEAR (SP10) during the coming year. Annihilation packages with spark chambers and scintillation counters have been added to the sides of the SPEAR magnetic detector for this purpose. (4) A novel large solid-angle Cerenkov detector is being designed and constructed for a direct electron counter experiment at SPEAR (SP25). The device will detect with high sensitivity the production of single prompt electrons produced in multihadron events and is prompted by high current interest in leptonic or semileptonic decay of new particles.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - F.R.D.

8.0008, CONFIGURATION-DEPENDENT PROPERTIES OF POLYMERIC CHAINS
P.J. FLORY, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (DMR76-20638)

This study falls in the general area of configurational statistics of chain molecules. This is a renewal of NSF Grant DMR73-07655. The focus has shifted somewhat from the treatment of characteristics such as the average mean square distance (r2) and the average square of the radius of gyration (s2) that represent the long polymeric chain as a whole to properties having a more local character. The study might be divided into three parts.

Part I of the study concerns the formation of cyclic molecules from acrylic chains. The peculiar dependence of the cyclization tendency on ring size has long been known and experimental results are available on a number of systems. Explanations will be sought for the conformation characteristics of the acyclic chain sequence and in the statistical probability that the ends of the sequence meet in a conformation with their terminal bonds in acceptable mutual orientation.

Part II comprises investigations of optical anisotropy - depolarized light scattering, electric birefringence and strain birefringence - of oligomers and polymers. These methods are sensitive to conformation and to stereochemical structure.

Part III will explore the use of synchrotron X-radiation, uniquely available in high intensity at the Stanford Synchrotron Radiation Facility, for small-angle scattering studies on polymer solutions. Initial work will be directed at the intermediate range of scattering wave vectors, (4 pi over lambda) sin (theta over 2) equals 0.01 to 0.5, suitable for proving correlations between relatively short sequences of the chain.

SUPPORTED BY U.S. Natl. Science Foundation

8.0009, PROGRAM IN HIGH-ENERGY PHYSICS RESEARCH
M. SCHWARTZ, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (PHY73-08920 A04)

The program consists of four major experiments being conducted at major installations in this country. It includes the following: 1. Search for pion-muon atoms: This effort has as its goal the demonstration of the existence of pion-muon atoms and is being performed in collaboration with a group from New York University at the Brookhaven AGS. 2. Search for mu meson production in high-energy proton collisions: This effort, being performed in collaboration with a group from Cal Tech, will measure at Fermilab the direct muon production in proton collisions with matter. The purpose of the experiment is to look for new states of matter which might give evidence for the speculative 'charm' quantum number.

3. Search for charmed states produced K zero L collisions: This experiment, to be performed at the Stanford Linear Accelerator Center, will use an existing facility to look for resonance states which might give evidence for the existence of charmed particles.

4. Search for new states of matter produced in e plus e minus annihilations: This experiment, to be performed at the electron - positron colliding beam facility (SPEAR) located at SLAC, will attempt to look for new states of matter by detecting electrons emanating from inelastic e plus e minus collisions.

This work is a continuation of that currently supported by Foundation grant number FY73-08950 A03.

SUPPORTED BY U.S. Natl. Science Foundation

8.0010, DIAGNOSTIC TECHNIQUES FOR COMBUSTION MHD PLASMAS
S.A. SELF, Stanford University, School of Engineering, *Palo Alto, California* 94305 (ENG73-04116 A01)

The research covers three areas of diagnostics related to combustion MHD plasmas, namely Langmuir probes, laser anemometry and infrared interferometry. The design and use of probes for local measurements of electron concentration in seeded combustion MHD plasmas will be investigated. Theoretical work on the use of Langmuir probes in flowing, atmospheric pressure plasmas will be directed towards extending the work of Clements and Smy to take account of the thermal boundary layer. The development of laser anemometry for high-resolution measurements of the profiles of average velocity and turbulence intensity in MHD boundary layers will be continued. The effort will be directed to developing a transit-timing anemometer combined with digital correlation to facilitate measurements at low-speed particle fluxes in the presence of noise generated by light scattered from channel surfaces. Far-infrared interferometric techniques will be investigated for absolute measurements of electron concentration.

For this purpose a far-infrared laser, optically pumped by a CO2 laser, will be developed. Initially measurements of moderate resolution will be made using Faraday rotation. Subsequently the use of finite- fringe interferometry for higher spatial resolution of electron concentration in boundary layers will be investigated.

SUPPORTED BY U.S. Natl. Science Foundation

8.0011, THEORETICAL PHYSICS
J.D. WALECKA, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (PHY75-18444)

Research will be concerned with the structure of elementary particles and their interaction, the structure of nuclei using elementary particles as probes, and the quantum theory of many-body systems.

This work represents a continuation of that currently supported by Foundation grant MPS73-08916A02.

SUPPORTED BY U.S. Natl. Science Foundation

8.0012, NUCLEAR PHYSICS AND RELATED RESEARCH IN ASTROPHYSICS, GEOPHYSICS AND TECHNOLOGY
T.A. TOMBRELLO, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (PHY76-02724 A01)

The research to be supported by this grant is in nuclear physics and related fields. It will be carried out in the Kellogg Radiation Laboratory, which has a history of significant contributions in these areas of research. The program covers many aspects of nuclear phenomena, particularly as they relate to stellar processes and how the geological and astronomical record of elemental and isotopic abundances can be analyzed to elucidate their production mechanisms. The research activities are: nuclear physics and experimental nuclear astrophysics, theoretical nuclear astrophysics, nuclear geophysics and planetary science, atomic physics, and applied nuclear physics. These areas are closely related, and there is considerable interaction between the projects.

This research is a continuation of that supported under PHY76-02724.

SUPPORTED BY U.S. Natl. Science Foundation

8.0013, MOLECULAR BEAM STUDIES OF SOLID SURFACES

D.R. MILLER, Univ. of California, School of Engineering, *San Diego, California* 92038 (DMR76-23009)

Experimental and theoretical studies of gas-surface interactions previously supported by NSF grant DMR74-08226 will be continued. These include: (1) atomic beam spectroscopy of surface structure and phonon excitation, (2) internal energy exchange, and (3) catalytic hydrogenation of carbon monoxide, using nickel, cobalt, and iron catalysts, to produce hydrocarbon fuels. Experimental studies of surface phonon excitation and internal energy exchange will be carried out using both time-of-flight and spectroscopic energy measurements. Low-energy helium atoms will be used to probe Ag and Au single-crystal surfaces at low temperatures by measuring the cross sections for energy and momentum exchange. Theoretical treatments will examine the effects of an attractive gas-surface potential and the accompanying effects of bound-state resonances on both elastic and inelastic scattering. Inelastic studies of polyatomic species will involve the simple diatomics N2, H2, D2. The internal rotational state distribution of N2 will be examined spectroscopically. A low-pressure reaction cell will be used to parametrically study the effect of temperature and H2:CO pressure ratios on hydrocarbon (CH4, CH3OH) production. Attempts to produce higher hydrocarbons (e.g., C2H4) will also be made. Molecular beam studies will be made to study the reaction mechanisms in more detail.

SUPPORTED BY U.S. Natl. Science Foundation

8.0014, THEORY OF ELECTRON AND LATTICE DYNAMICS IN SOLIDS

L.J. SHAM, Univ. of California, Graduate School, *San Diego, California* 92037 (DMR73-07593 A02)

Research previously supported under GH-38345 will be continued and extended. The effects of interacting electrons and phonons on the properties of crystalline solids will be studied. The research may be divided into three categories: 1) Study of structural instabilities in quasi-one-dimensional conductors, where the theory developed by Sham and Patton will be extended to treat the optical properties of potassium cyano-platinide (KCP) and to calculate the temperature dependence of the lattice dynamics of TTF-TCNQ. Studies of the D.C. conductivity of these materials will also continue. 2) Investigations of the connection between lattice instabilities and high-temperature superconductivity in both A-15 and C-15 type materials. 3) Refinement of the theory of dielectric response of semiconductors developed by Sham and Hanks to treat excitonic effects in a more consistent fashion, and application to electron scattering spectra, modulation spectroscopy lineshape, synchrotron radiation absorption, and other processes.

SUPPORTED BY U.S. Natl. Science Foundation

8.0015, PROBLEMS IN THEORETICAL PHYSICS

R.F. SAWYER, Univ. of California, School of Letters & Science, *Santa Barbara, California* 93106 (PHY76-11448)

Research will be carried out in two areas of particle physics: 1. In the area of high-energy hadron interactions work will continue on the problem of scattering and particle production at high energies studied by means of the Reggeon field theory. There will also be study of the problem of particle production at intermediate energies in Reggeon field theory and in models which incorporate direct channel unitarity; and study of the problem of quark confinement in gauge field theories. 2) In the area of high-energy phenomena in nuclear matter there will be examination of some consequences, in high-energy particle- nucleus collisions, of existing models of the pion propagator in nuclear matter. The suggeston is that by analyzing pion production in the nuclear fragmentation region, one may be able to study rather specific properties of the dispersion relation for a pionic excitation in nuclear matter. Work is planned on the role, in the fragmentation process, of other possible high-energy collective excitations of nuclear matter.

This work is a continuation of that previously supported by Foundation grant PHY74-12678AO1.

SUPPORTED BY U.S. Natl. Science Foundation

8.0016, MICROWAVE RELAXATION AND MICROSTRUCTURE IN POLYCRYSTALLINE FERRITES 12240-EL

C.E. PATTON, Colorado State University, School of Science, *Fort Collins, Colorado* 80521 (DA0E8972; DAHC04-75-G-0010)

To investigate mechanisms which determine the microwave losses in polycrystalline ferrites in order to provide a generally valid picture of ferrite relaxation and to give a basis for improved materials development. Phase shifters contribute the biggest share to the cost of phased arrays. This proposal aims at improving technology with respect to performance and price of ferrites to be used in phase shifters. Primary potential payoff will occur in SAM-D phased arrays.

The temperature and frequency dependence of spinwave linewidth, transit-time relaxation, magnetostriction and other loss mechanisms will be investigated for Li-ferrite and YIG by systematic variation in microstructure parameters. Also, correlation between microstructure and high-power properties will be made.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box CM, Duke Station, Durham, N.C. 27706

SUPPORTED BY U.S. Dept. of Defense - Army

8.0017, FIRST PRINCIPLES CALCULATION OF FERROELECTRIC AND PIEZOELECTRIC SOLIDS

J.H. HENKEL, Univ. of Georgia, School of Arts & Sciences, *Athens, Georgia* 30602 (DF044180; AF-AFOSR-3045-76)

AF function - microwave electronic devices are essential elements of Air Force reconnaissance and surveillance systems. Opportunity - improved performance in these systems can be expected from the use of better solid-state materials in devices. Objective - the objective is to calculate energy bands, polarization, pyroelectric coefficients and piezoelectric coefficients of several ferroelectric crystals including lithium niobate and lithium tantalate. How work contributes - this research will identify those materials which have the best prospects for use in electronic devices such as pyroelectric image tubes.

The calculational technique is based on a Hartree-Fock formulism which requires no input of experimental data other than crystal symmetry and involves no adjustable parameter.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: AF Office of Scientific Research NE, Bldg. 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0018, INELASTIC SCATTERING OF MEDIUM-ENERGY PROTONS AND HEAVY IONS - NUCLEAR STRUCTURE AND REACTION MECHANISMS

A. SCOTT, Univ. of Georgia, School of Arts & Sciences, *Athens, Georgia* 30602 (PHY76-08788)

This is a user program using facilities at a number of laboratories. The research will involve the study of inelastic proton scattering at 150 MeV from the nuclei Pb207, Mo92 and Zr92 using the Indiana cyclotron.

The thrust of this work is to study simple states and examine the effective interaction at high bombarding energy where it is expected to be fairly simple. Some work on heavy-ion inelastic scattering to study Coulomb-nuclear interference will be carried out at the Oak Ridge National Laboratory.

SUPPORTED BY U.S. Natl. Science Foundation

8.0019, THEORETICAL SOLID-STATE PHYSICS
M.H. COHEN, Univ. of Chicago, Graduate School, *Chicago, Illinois* 60637 (DMR76-21298)

A broad program of research in the theory of condensed matter will be carried out by the solid-state theory group of the James Franck Institute of the University of Chicago. Emphasis will be on: (1) Highly anisotropic organic metals and semiconductors. The emphasis here is on the electron-lattice interaction in nearly one-dimensional systems and its effect on transport, and on the role of disorder. (2) Low- temperature liquid He3. Of particular interest is the role of paramagnons in producing the triplet-paired superfluid state. (3) Fluctuations, collective modes and critical dynamics. This section includes work on coupling between single-particle and collective modes and between different collective fluctuations in magnetic systems, studies of static and dynamic fluctuations in some one-dimensional models, and investigations of the critical dynamics of both classical and quantum systems. (4) Disordered systems. The interest here focuses on metal-nonmetal transitions, the effects of interaction among localized electrons, and on the nature of magnetic phase transitions in the presence of disorder. (5) Dynamics of simple fluids. The relation of features in experimental data to microscopic theory is of special importance here. Collaboration with the neutron scattering group at Argonne will be carried out. (6) A careful study of the competition between magnetic and superfluid order in strongly paramagnetic metals will be undertaken.

SUPPORTED BY U.S. Natl. Science Foundation

8.0020, ELEMENTARY PARTICLE PHYSICS
Y. NAMBU, Univ. of Chicago, Graduate School, *Chicago, Illinois* 60637 (PHY74-08833 A01)

Research previously supported under grant GP-32904X2 will continue. Topics include: parton model, quark model, dual resonance and statistical bootstrap models, gauge theories, high-energy cross sections, and weak interactions.

SUPPORTED BY U.S. Natl. Science Foundation

8.0021, RECOIL STUDY OF REACTIONS INDUCED IN LIGHT ELEMENTS BY HIGH-ENERGY PROTONS (3 TO 300 GEV)
L. WINSBERG, Univ. of Illinois, School of Liberal Arts & Sci., *Chicago, Illinois* 60607 (E(11-1)-2324)

Our object is to elucidate the mechanism of the various nuclear reactions induced in complex nuclei by high-energy protons. The recoil properties of Be7 from the target Al27 will be measured, thus completing the work with this target. We will then join groups from the Argonne National Laboratory, Purdue University, and the University of Chicago on a measurement of the angular and range distributions of nuclei recoiling from targets bombarded with 400-Gev protons. Initially, the target will be uranium, since a variety of interesting phenomena have been observed with uranium targets.

In the first study we will measure the Be7 activity in each of 5 aluminum foils exposed as a stack to the circulating beam of the Zero Gradient Synchrotron of the Argonne National Laboratory. The Be7 recoil range will be determined from the amount of this nuclide that has recoiled out of the two outer foils, as determined by comparing the activity in these foils with that in the inner foils.

RESULTS: The recoil properties of C11, F18, Na22, and Na24 from the bombardment of 1- to 300-Gev protons on an Al27 target have been measured. A similar study has been completed on Tb149 from a Au197 target (0.7 to 300 Gev). There appears to be little, if any, change in the mechanisms of these reactions in this range of proton energies.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0022, HIGH-ENERGY EXPERIMENTAL PHYSICS
D.H. MILLER, Northwestern University, School of Arts & Sciences, *Evanston, Illinois* 60201 (E(11-1)-2289)

We propose to continue our studies of the interactions of elementary particles using the secondary beam facilities provided by accelerators at National Laboratories. The detection equipment used consists of scintillation counters, proportional and drift chambers.

Present studies include: 1) A search for short-lived high-mass particles which might carry the heretofore unobserved, but widely speculated, quantum number 'charm'. 2) A determination of the full scattering amplitudes for elastic proton-proton scattering using polarized beams and targets to 12 GeV/c. 3) Studies of neutrino interactions using the dichromatic beam at Fermilab.

RESULTS: 1) An initial search has been completed; no evidence for long-lived states with mass greater than 2 GeV was observed in two-body effective-mass distributions. The new search will include a muon in the trigger. 2) The spin correlation parameter CNN has been measured from 2-6 GeV/c. The measurements provide critical tests for existing models of the p-p interaction at intermediate energies. 3) Deep inelastic distributions and total elastic cross sections have been measured in the dichromatic neutrino beam.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0023, ELEMENTARY PARTICLE THEORY
R.J. OAKES, Northwestern University, School of Arts & Sciences, *Evanston, Illinois* 60201 (PHY76-11445)

Oakes' general area of research will continue to be the theory of the interactions of elementary particles at very small distances. Specific research projects to be investigated are in the areas of quark models, gauge theories, neutrino scattering, SU(4) x SU(4) chiral symmetry breaking, the UA(1) problem, lepton production in hadron collisions and multichanneled scattering phenomenology.

SUPPORTED BY U.S. Natl. Science Foundation

8.0024, QUANTUM MANY-BODY PHYSICS
C. WOO, Northwestern University, School of Arts & Sciences, *Evanston, Illinois* 60201 (PHY73-05007 A02)

Theoretical research in formal quantum many-body theory initiated under NSF grant MPS73-5007A01 will be continued. Topics with applications to nuclear physics and astrophysics to be studied include: 1. Calculational techniques for Fermi systems; 2. Quantum crystals; 3. Surface properties of nuclear matter.

SUPPORTED BY U.S. Natl. Science Foundation

8.0025, STUDIES IN QUANTUM FIELD THEORY
S.J. CHANG, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (MPS 75-21590)

Quantum field theory is the union of quantum mechanics and relativity theory. It provides a framework suitable for the study of the fundamental interactions of nature - the strong, the electromagnetic, and the weak interactions of elementary particles. Research by the group includes the following: (1) classical field theories describing quarks, the hypothesized building blocks of elementary particles, and their interactions; (2) predictions of Yang- Mills fields, the natural generalization of electromagnetism, for the structure of particles; (3) examination of the roles of the Regge and multiperipheral approaches to high-energy diffraction scattering; (4) the special properties of mass zero particles in physical theories; (5) the role of vector mesons, including the newly discovered particles, in hadronic structure; (6) prediction for the production of new, heavy leptons in e plus e minus colliding-beam experiments.

SUPPORTED BY U.S. Natl. Science Foundation

8.0026, THEORETICAL PARTICLE PHYSICS
D.G. RAVENHALL, Univ. of Illinois, Graduate School, *Urbana, Illinois* 61801 (PHY75-21590)

Theoretical studies will include work on: 1) Strong interaction phenomenology; 2) Quark confinement; 3) Generalized vec-

tor dominance in deep inelastic scattering; 4) Frontier studies in field theory; 5) Scattering of particles from nuclei and nuclear physics.

This work is a continuation of that currently supported by Foundation grant number MPS73-05103 AO1.

SUPPORTED BY U.S. Natl. Science Foundation

8.0027, THEORETICAL STUDIES IN MAGNETOHYDRODYNAMIC FLOWS

J.S. WALKER, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (ENG74-23778)

Theoretical studies will treat liquid-metal flows in the presence of transverse magnetic fields. The first study will cover periodic and solitary compression waves in rectangular ducts and circular pipes with uniform magnetic fields. The second study will treat open-channel flows. Steady, variable-depth flows with uniform magnetic fields and unsteady, established flows created by the travelling, sinusoidal magnetic fields in A.C. induction pumps will be examined. In the last study, steady flows in ducts or pipes with non-uniform magnetic fields will be considered. This analysis will be restricted to flows with strong magnetic fields throughout the ducts. The matter of entry into an applied magnetic field will follow. There are strong circulations of current wherever a flow enters or leaves an applied magnetic field and the Joule heating in these circulations accounts for a major part of the energy losses in many engineering applications of MHD. A problem to be solved is the flow in an infinite duct or pipe with an applied magnetic field which changes slowly from zero field strength at x equals minus infinity to a uniform field at x equals plus infinity, where the x-axis is taken as the centerline of the duct or pipe. Assuming that all variations in the x-direction are small, the governing equations would be simplified and would hopefully then yield a solution for the flow evolving slowly from fully developed Poiseuille flow at x equals minus infinity to fully developed MHD flow at x equals plus infinity. This solution would also give the currents circulating in cross sections and in planes along the pipe or duct and would thus give the total Joule heating for this prototype.

SUPPORTED BY U.S. Natl. Science Foundation

8.0028, THEORETICAL PARTICLE PHYSICS

S. CHU, Indiana University, Res. Division, *Bloomington, Indiana* 47401 (E(11-1)2009,TASK B)

We propose to carry out several phenomenological analyses in hardron scattering, and to investigate various aspects of quark models incorporating charm.

In hardron scattering, it now seems clear that interactions involving spin effects are much more important than previously realized. This is especially evident in the recent measurements of various spin correlations in proton-proton elastic scattering. We intend to study these effects in detail in order to evaluate the helicity scattering amplitudes, as well as to help analyze the upcoming measurements, at the Fermi National Accelerator Laboratory and Argonne, of proton polarization, to be done this coming year by the Indiana University Experimental Group (Task A). We also plan to complete a phase-shift analysis in the pion-nucleon system, and to obtain improved values of the masses and widths of hadron resonances.

Our work on quark models with charm is stimulated by the recent discoveries of new mesons at SLAC, Brookhaven, and DESY. We intend to make various calculations to see how they fit together with the present system of hardrons, and to estimate the masses and widths of other states in this enlarged scheme.

RESULTS: We have studied some spin-correlations in pp scattering, begun a pi N phase-shift analysis at intermediate energies, obtained more precise values of the masses and widths of the delta ions, delta zero, sigma* ion, and sigma* - resonances, calculated meson and baryon mass relations in the charmed quark model, calculated the positive pion - pi zero mass difference within the framework of the quark mode, considered the triple-Pomeron vertex as a cause of rising total cross sections, and begun an investigation of Yang's theory of gravity.

Part 2 of 2.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0029, INVESTIGATIONS IN THE THEORY AND INTERPRETATION OF PARTICLE COLLISIONS

R.G. NEWTON, Indiana University, School of Arts & Sciences, *Bloomington, Indiana* 47401 (PHY75-18942)

Theoretical research in general quantum scattering theory will continue. Topics will include work on the 3- and n- body problems, the determinantal method, specific three-nucleon calculations, and the inverse scattering problem for three-dimensional potentials that are not spherically symmetric.

This work is a continuation of that currently supported by Foundation grant GMPS71-03310 AO2.

SUPPORTED BY U.S. Natl. Science Foundation

8.0030, THEORETICAL STUDY OF INTERACTION OF ELEMENTARY PARTICLES

M. SUGAWARA, Purdue University, School of Physics, *Lafayette, Indiana* 47907 (E(11-1)-1428 Task B)

The proposed research consists of theoretical studies of interactions among various elementary particles including unstable particles or resonances.

One area of special emphasis is the study of elementary particles along the line of the new gauge theory of weak and electromagnetic interactions primarily due to Weinberg. We place special emphasis not only because it is the first, and possibly the last, successful theory of weak interactions, but also because it is so strongly internally constrained that many nontrivial consequences follow for hadronic interactions as well.

One special project along this line concerns the question of whether or not one has to introduce the new quantum number, called charm, to hadrons. This project proposes to avoid charm, which is in fact possible if weak interactions are due to two sets of weak vector bosons instead of one set which is usually assumed. This project is to study various consequences of this new proposal.

RESULTS: For the period of June 1, 1974, to May 31, 1975, the results are summarized in the Annual Progress Report, E.R.D.A. report No. COO-1428-416, which consists of numerous publications on a variety of subject matters which are of current interest in elementary particle physics.

Part 1 of 4.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0031, ROTATION - ALIGNED COUPLING AND AXIAL ASYMMETRY IN THE NEUTRON-DEFICIENT LANTHANUM NUCLEI

E.F. ZGANJAR, Louisiana State Univ. Systems, School of Arts & Sciences, *Baton Rouge, Louisiana* 70803 (E(40-1)-4935)

The picture which has been applied to the high-j unique parity states of neutron-deficient odd-A nuclei, such as Au and La, is the model of a single nucleon with j greater than 9/2 coupled to a triaxial even-even core with coriolis and paring forces included. Our investigation in the odd-Au nuclei has shown that the h-11/2 band structures are consistent with the triaxial-rotor model. The most impressive demonstration of this occurred in 189-Au where the h-11/2 and h-9/2 bands show a remarkable symmetry. The symmetry in this case arises from the fact that 188-Pt and 190-Hg, which are taken to be the effective cores for a particle and a hole state in 189-Au, have triaxial shapes which are analogs of one another.

It is proposed to extend these investigations to the neutron-deficient La nuclei produced from the beta-decay of the corresponding Ce parents in order to locate the low-spin and non-yrast states which are not populated in the in-beam studies. The triaxial-rotor model appears to be applicable to these odd-A La nuclei and the location of the non- yrast states, and the determination of the corresponding transition probabilities is crucial to testing these ideas since the properties of these states are much more sensitive to the parameters of the model than are the properties of the yrast states.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0032, RESEARCH IN THEORETICAL PHYSICS

G. DOMOKOS, Johns Hopkins University, School of Arts & Sciences, *Baltimore, Maryland* 21218 (E(11-1)3285)

OBJECTIVE OF RESEARCH: Understanding existence of triality rule in quark theories of hadrons; broken conformal (Weyl) invariance. Proposed to investigate algebraic structures exhibiting triality Hurwitz or Rozenfeld algebras. Commutative field of coefficients to be replaced by exterior algebra, necessary to satisfy Pauli principle for observed states. Propose to investigate Feynman quantization scheme for algebras of dynamical variables described. Broken local rescaling (Weyl transformation) to be investigated as possible origin of mass scales in QU. gravity. Algebraic construction performed exhibiting triality, separate conservation of baryon and lepton numbers. Preliminary investigation performed. Quantization scheme in terms of Feynman Path Integrals found for wide class of algebraic structures including all physically acceptable models. De Sitter invariant vacuum solutions were found in conformal relativity. Discovered less than 'Second Higgs Mechanism' permitting elimination of scalar particles from physical spectrum.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0033, SOME PROBLEMS IN THEORETICAL PHYSICS
T. FULTON, Johns Hopkins University, Graduate School, *Baltimore, Maryland* 21218 (PHY75-01052 A01)

This provides support for research previously funded under NSF Grant GP-35872X1.

Theoretical research will focus on studies of positronium and the Bethe-Salpeter equation, weak and electromagnetic interactions of nuclei, general work interaction theory, and field theory.

SUPPORTED BY U.S. Natl. Science Foundation

8.0034, HIGH-ENERGY PARTICLE PHYSICS
A. PEVSNER, Johns Hopkins University, Graduate School, *Baltimore, Maryland* 21218 (PHY75-14070 A01)

The Johns Hopkins group is performing the following experiments in elementary particle physics: 1. Study of wide-angle photons at Fermilab; 2. Construction of Large-Angle Spectrometer System (LASS) and study of high transverse momentum processes at the Stanford Linear Accelerator Center (SLAC); 3. Hadronic processes in the Fermilab 30- inch bubble chamber; 4. K-d interactions at 12 GeV/c in the SLAC 82- inch bubble chamber.

This work is a continuation of that currently supported by Foundation grant number PHY75-14070.

SUPPORTED BY U.S. Natl. Science Foundation

8.0035, ELEMENTARY PARTICLE THEORY AND QUANTUM FIELD THEORY
O.W. GREENBERG, Univ. of Maryland, School of Arts & Sciences, *College Park, Maryland* 20742 (PHY76-16562)

Research initiated under NSF grant PHY74-11491 A01 will be continued. Among the topics in elementary particle theory to be pursued are: Greenberg: 1. Models of new narrow resonances; 2. Bound states in quantum field theory. Pati: 1. Fermion number and its conservation; 2. Neutral currents; 3. Unified gauge theories; 4. New quantum numbers; 5. Decay of quarks with integer charge.

SUPPORTED BY U.S. Natl. Science Foundation

8.0036, FOUNDATIONS OF RELATIVISTIC QUANTUM THEORY, INTERACTIONS OF HADRONS, AND ELECTROMAGNETIC INTERACTIONS OF ELEMENTARY SYSTEMS
J. SUCHER, Univ. of Maryland, School of Arts & Sciences, *College Park, Maryland* 20742 (PHY74-02211 A02)

Research on problems in the domain of quantum field theory and the interactions of elementary particles initiated under NSF grant MPS74- 02211 AO1 will be continued. Specific topics planned for investigation include: (1) quantum electrodynamics of rare decays of the new particles, (2) CP violation and time evolution of the neutral kaon - neutral kaon system, (3) almost point-like behavior of off-shell particles in field theory, (4) universal gauge theories, (5) renormalizability constraints for massive vector-meson field theories, (6) renormalization and new symmetries in non-abelian gauge theories, (7) electromagnetic polarizabilities in relativistic quantum theory, (8) stability analysis of nonlinear field equations, soliton solutions and their quantization.

SUPPORTED BY U.S. Natl. Science Foundation

8.0037, HIGH-ENERGY PHYSICS - SPARK CHAMBER PROGRAM
M.N. KREISLER, Univ. of Massachusetts, Graduate School, *Amherst, Massachusetts* 01002 (PHY73-08446 A04)

In collaboration with a research group from Princeton University, this group at the University of Massachusetts will conduct an experiment at the Brookhaven Alternating Gradient Synchrotron to measure the rate for the decay process lambda degrees yields p plus e minus plus nu to occur. The experiment is a high statistics study and is expected to result in observed events greater by at least a factor of ten than the world's presently observed total. Knowledge to be gained from the experiment will elucidate substantially understanding of the nature of weak interactions, particularly the validity of the Cabibbo theory and the possible existence of second-class currents. In addition, searches will be made for processes involving a change in strangeness of two units, a process which has never been observed before in weak interaction studies.

This work is a continuation of that currently supported by Foundation grant number PHY73-08446 A03.

SUPPORTED BY U.S. Natl. Science Foundation

8.0038, ELEMENTARY PARTICLE THEORY
R. ARNOWITT, Northeastern University, School of Liberal Arts, *Boston, Massachusetts* 02115 (PHY76-11455)

Theoretical research will include work on the following topics: 1. Gauge supersymmetry and unified gauge theories; 2. Pion production near threshold by neutral currents.

This work is a continuation of that currently supported by Foundation grants PHY75-14744 and PHY71-03134A04.

SUPPORTED BY U.S. Natl. Science Foundation

8.0039, ELEMENTARY PARTICLE PHYSICS
M. GETTNER, Northeastern University, School of Liberal Arts, *Boston, Massachusetts* 02115 (PHY75-21592)

This group, in collaboration with groups from Cornell, McGill, and the Lebedev Institute, is undertaking the measurement at Fermilab of proton-proton elastic scattering at large four-momentum transfers (t less than -4Gev/c2) and incident energies above 100 Gev. The experiment will cover the t range of 4(Gev/c)2 less than (-t) less than 20(Gev/c)2 with a cross-section sensitivity of 10 to the minus 38th power cm2/(Gev/c)2, which represents a fourfold increase in t range and four- orders-of-magnitude improvement in cross-section sensitivity than results presently available from the CERN Intersecting Storage Rings.

SUPPORTED BY U.S. Natl. Science Foundation

8.0040, PARTICLE THEORY
H. GOLDBERG, Northeastern University, School of Liberal Arts, *Boston, Massachusetts* 02115 (PHY76-11456)

Theoretical research will include: 1. Data analysis of the reaction piN yields pi piN in the C.M. energy region 1300-2200 MeV using a unitary and analytic isobar model; 2. study of the 3 pi system in the region of the A1 resonance using relativistic three-body equations; 3. studies of CP-violation and very heavy quarks; 4. study of photon-photon scattering in colliding beams. 5. A regge approach to confinement in YM color theories.

This work represents a continuation of that currently supported by Foundation grant PHY71-03134 A04.

SUPPORTED BY U.S. Natl. Science Foundation

8.0041, MESON PROPERTIES AND DOUBLE ELECTRON PAIR PRODUCTION
R. WEINSTEIN, Northeastern University, School of Liberal Arts, *Boston, Massachusetts* 02115 (PHY75-22937)

A program to study properties of strong interactions at very high energies will be conducted at the Fermilab. Included in the program are the following components: 1. Missing mass studies of reactions pi p yields px, pi d yields dx and pi d yields px at energies between 40 and 240 Gev. This experiment will search for possible new states with masses up to 13 Gev. 2. Search for high mass states with prompt decay into one or more muons. Candidates for such states may be pairs of charmed particles, singly produced heavy bosons or heavy leptons. 3. Production of psi and other states produced by incident pions, kaons, protons in an iron target and decaying into mu meson pairs.

SUPPORTED BY U.S. Natl. Science Foundation

8.0042, MATHEMATICAL PHYSICS
A. JAFFE, Harvard University, School of Arts & Sciences, *Cambridge, Massachusetts* 02138 (MPS75-21212)

Research will focus on the mathematical foundations of quantum field theory, and on the connections between field theory and statistical mechanics. A deeper understanding of field theory models in two space-time dimensions will be pursued, as will the construction of models in three dimensions. This work represents a continuation of that currently supported by Foundation grant MPS-7305037A01.

SUPPORTED BY U.S. Natl. Science Foundation

8.0043, STUDIES OF ADSORPTION AND CHARGE TRANSFER ON SEMICONDUCTOR SURFACES
H.C. GATOS, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (ENG75-00521)

Transfer of electric charges during chemisorption on semiconductor surfaces and its fundamental role to catalytic processes has been recognized for over twenty-five years; quantitative theoretical models have been developed based on the energy position and dynamic parameters of surface states within the forbidden energy gap. Although there is extensive experimental evidence in support of the charge transfer models in catalytic processes, it is essentially of a quantitative nature, primarily because of experimental difficulties and uncertainties associated with the control and determination of the electronic characteristics of the surfaces. These difficulties have been recently overcome through the development of surface photovoltage spectroscopy, which is based on the photo population and photo depopulation of the surface states. In addition, piezoelectrics recently discovered make it possible to alter at will the electronic characteristics of the surfaces without changing the chemical composition of the material. Both of these techniques will be used in this research. In the first stage of this investigation the role of charge transfer in chemisorption on semiconductor surfaces will be studied. The salient parameters which control charge transfer, such as the surface potential barrier, the free carrier density at the surface, the capture cross section of the surface states for electrons or for holes, and the activation energy will be directly determined. In the second stage, a catalytic reaction will be studied: the oxidation of carbon monoxide to carbon dioxide on high-energy gap semiconductor surfaces (i.e., zinc oxide). The chemisorption of each species will be individually studied. It is believed that establishing the role of the electronic parameters of the surfaces in charge transfer chemisorption will permit for the first time the quantitative study of catalytic processes in which charge transfer among the reacting species takes place via the semiconductor catalytic surfaces.

SUPPORTED BY U.S. Natl. Science Foundation

8.0044, CRYSTAL GROWTH BY SKULL MELTING 14080-PX
A. LINZ, Mass. Inst. of Technology, Graduate School, *Cambridge, Massachusetts* 02139 (DA0E9123; DAAG29 76 C 0039)

To develop the skull growth of high-purity yttrium vanadate crystals. Relevance - yttrium vanadate crystals are attractive as a laser host material for use in laser range finders and target designators. This program will address the development of a growth technique for which crystals may be obtained free of inclusions, bubbles, and cleavage fractures due to poor diameter control.

A detailed electrical and thermal analysis of the skull system will be carried out to predict temperature profiles - electrical conductivity measurements will be obtained on the solid and liquid phases - and design of the skull growth process and growth and characterization of high-purity vanadate crystals will be investigated.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0045, RESEARCH IN ELEMENTRARY PARTICLE PHYSICS
L. KIRSCH, Brandeis University, School of Science, *Waltham, Massachusetts* 02154 (E(11-1)-3230)

Experiments at the Brookhaven National Laboratory Multiparticle Spectrometer Facility to search for charged particles, and to continue work on meson and baryon spectroscopy.

Research in theoretical physics will concentrate on non- perturbative methods in quantum field theory. It is proposed to continue the development of the 1/N expansion as a systematic calculational method which avoids a conventional coupling-constant expansion. In addition, work will be carried out on semi-classical techniques in field theory, with particular attention paid to the extension to four-dimensional theories.

RESULTS: Data acquisitions for antiproton p yields V degrees plus neutrals at 3 Gev/c and negative Kaon P yields K* (1760)p at Gev/c has been completed.

It has been shown that the 1/N expansion is a consistent expansion method for lambda phi 4 theory in four dimensions. Genuine non- perturbative effects have been exposed in this and related models.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0046, NUCLEAR STRUCTURE THEORY
K.T. HECHT, Univ. of Michigan, School of Liberal Arts, *Ann Arbor, Michigan* 48104 (MPS75-18443)

Research initiated under NSF grant GP-25864, Amendment 1, will be continued. Among the topics in nuclear structure theory to be investigated are: (1) spectroscopic amplitudes for few-nucleon transfers in heavy ion reactions, and gamma-clustering phenomena, (2) the use of special coupling schemes, in particular the pseudo SU3 model, in a study of the properties of high spin states and the phenomenon of decoupled h11/2, and I13/2 bands, (3) use of the spectral distribution technique as a tool in testing the goodness of nuclear symmetries.

SUPPORTED BY U.S. Natl. Science Foundation

8.0047, QUANTUM THEORY OF FIELDS
S.N. GUPTA, Wayne State University, School of Liberal Arts, *Detroit, Michigan* 48202 (E(11-1)-2302)

The research program will continue to deal with the development of basic theories of strong, weak, electromagnetic, and gravitational interactions as well as their applications to fundamental physical processes. In the near future, emphasis will be on the quantization of gauge fields within the framework of the standard field theory but without the use of the path-integral formalism.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0048, CONSTRUCTION OF A PROTOTYPE HIGH-PRECISION SUPERCONDUCTING MAGNET
H.G. BLOSSER, Michigan State University, Cyclotron Laboratory, *East Lansing, Michigan* 48824 (PHY75-01080 A02)

This project consists of the design and development of a magnet which produces, for the first time, an azimuthally-varying magnetic field in the neighborhood of 5 tesla. The high field will be achieved using superconducting coils.

This year's funding will permit procurement of the cryogenic components and the magnet yoke and pole tips.

This work is a continuation of that currently supported by Foundation grant PHY75-01080 A01.

SUPPORTED BY U.S. Natl. Science Foundation

8.0049, RESEARCH IN NUCLEAR PHYSICS
J.M. BLAIR, Univ. of Minnesota, School of Physics, *Minneapolis, Minnesota* 55455 (E(11-1)-1265)

During 1976 the MP tandem Van de Graaff and associated auxiliary equipment will be used for experiments in the following areas: Precision p-p scattering; reactions and scattering of beams of p, d, H3e and He4 with a wide range of targets; scattering and reactions of beams of heavy ions (C, O, F) with medium and heavy elements; and extension of study of hyperfine structure using laser light. Participation in the work at Los Alamos on the high-resolution spectrometer will continue.

RESULTS: During 1974 ion beams from the tandem Van de Graaff were used in studies of nuclear structure and reactions. These include measurements of elastic and inelastic scattering of p, d, He3 and He4 beams on a range of light-nuclei measurements of one- and two-nucleon transfer reactions in medium-weight nuclei, and the use of oxygen ion beams on targets from Si to Fe. Laser techniques were used to study optical hyperfine structure in Yb. X-ray production by ion bombardment was also studied.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0050, PROPERTIES OF GASEOUS PLASMAS BY MASS SPECTROMETER AND LIGHT SPECTROMETER TECHNIQUES
H.J. OSKAM, Univ. of Minnesota, School of Engineering, *Minneapolis, Minnesota* 55414 (ENG76-10905)

Studies will be undertaken on the properties of and the collision processes occurring in gaseous discharge plasmas produced in atomic and molecular gases and their mixtures. The studies are: (1) The measurement of the line broadening of the 10,830 A helium line during the helium afterglow. These studies will determine the type of electron-ion recombination process involving He ion 2; (2) A study of the properties of the metastable helium molecule He2(2s a3 u ion). Prior research has determined that this metastable molecule strongly influences the properties of plasmas produced in gases in which helium is the major gas component; (3) A study of the properties of plasmas produced in rare gas-nitrogen mixtures. Studies of excitation transfer in krypton-nitrogen mixtures and in xenon-nitrogen mixtures are proposed; (4) The measurment of the dependence of the reaction rate constant for the ion conversion process X ion plus 2X yields X ion 2 plus X on gas temperature; (5) Discharges in gases containing oxygen. As a transition to the study of plasmas produced in mixtures of molecular gases (N2 single bond CO2, N2 double bond CO, etc.) it is planned to make a detailed study of plasmas produced in an electronegative gas. The purpose of these studies is to evaluate the value of existing diagnostic methods. Consequently, studies of plasmas produced in rare gas-oxygen mixtures are planned.

The research is a continuation of work done under NSF Grant ENG- 7304157.

SUPPORTED BY U.S. Natl. Science Foundation

8.0051, THEORETICAL SOLID-STATE PHYSICS
E. ABRAHAMS, Rutgers the State University, School of Arts & Sciences, *New Brunswick, New Jersey* 08903 (DMR76-23330)

Research in theoretical solid-state physics carried out under grant DMR72-03230 will be continued. In particular, the program will be directed toward three general problems: (1) transport coefficients of the normal Fermi liquid will be calculated by extending Eliashberg's theory to include finite temperature corrections. (2) The coupling of electrons to sound waves in piezoelectric materials will be studied, including the effect of this coupling on transport properties. (3) Research on dynamical phenomena near the lambda transition in liquid helium will be continued.

SUPPORTED BY U.S. Natl. Science Foundation

8.0052, THEORETICAL NUCLEAR PHYSICS
P. GOODE, Rutgers the State University, School of Arts & Sciences, *New Brunswick, New Jersey* 08903 (PHY75-06858 A01)

Investigations in theoretical nuclear physics in the areas of nuclear structure, nuclear reactions and in intermediate-energy physics which were initiated under NSF grant GP-39126X1 will continue.

In nuclear structure physics they shall be working on such problems as density-dependent interactions and the energies of breathing mode states; the development of a collective theory of high-frequency vibrations in nuclei (e.g. of the giant multipole states) and comparison with particle-hole calculations; structure of spin-isospin resonances and their fragmentation into more complicated states; the reasons for the values of isospin-forbidden transitions in light nuclei; the need for long-range components in the nuclear effective interactions.

In nuclear reaction theory, they will be working on the construction of optical potentials for heavy-ion scattering using density-dependent (saturating) interactions, the development of a heavy- ion code (in collaboration with Argonne) for the study of elastic, inelastic, and transfer reactions and the degree to which various heavy- ion approximations in standard use are valid. A wave packet theory of lifetimes is being developed to understand the results of crystal blocking experiments.

In the field of intermediate-energy physics, sum rules recently developed by Lane and Mekjian will be used to study muon and pion capture rates. The sum rules include nuclear correlations. The effect of exchange currents on isovector excitations at high-momentum transfer is also being studied.

SUPPORTED BY U.S. Natl. Science Foundation

8.0053, LOW-TEMPERATURE PROPERTIES OF SOLIDS
P. LINDENFELD, Rutgers the State University, School of Arts & Sciences, *New Brunswick, New Jersey* 08903 (DMR76-22967)

This research program is an extension of that carried out under NSF grant DMR72-03215. It includes the continuation of work in progress as well as the development of areas of investigation which are related to and grow out of recent research results. It includes the following studies: 1. Thermal measurement on granular aluminum films; 2. Magnetic and electric measurements on granular aluminum films; 3. Relaxation time of the superconducting order parameter; 4. Proximity effect; 5. Structural limitations to the phonon mean free path; 6. Flux entry into high-Tc superconductors.

SUPPORTED BY U.S. Natl. Science Foundation

8.0054, RESEARCH AT RUTGERS NUCLEAR LABORATORY
G.M. TEMMER, Rutgers the State University, Graduate School, *New Brunswick, New Jersey* 08903 (PHY75-00950 A02)

This research program includes nuclear reaction studies, particularly with polarized beams, plus very active work on solid-ion interactions, particularly blocking and channeling of ions.

This work represents a continuation of that supported under Foundation grant no. PHY75-00950 A01.

SUPPORTED BY U.S. Natl. Science Foundation

8.0055, MAGNETIC RESONANCE, OPTICAL, AND ELECTRON SCATTERING SPECTROMETRY OF SOLIDS
T.R. CARVER, Princeton University, Graduate School, *Princeton, New Jersey* 08540 (DMR76-18667)

Research on the optical and magnetic properties of condensed matter previously supported by NSF grant DMR72-03168 will be continued. The recently constructed infrared ellipsometer will be tested by measurement of the optical properties of gold in the wavelength range from 2 to 14 microns. Then transferred metals will be studied in order to test the proposed relation between infrared optical properties and superconducting transition temperatures. Work in magnetic resonance will include studies of the critical exponent beta in several magnetic metals by a new method involving zero applied field. This method involves measurement of the temperature swept magnetic resonance transmission which has been sucessfully tried in nickel. Also, experiments on low-frequency conduction electron resonance in aluminum will be continued. New work will be initiated concerned with the development of new methods for measuring the magnetization and susceptibility of spin glasses at low applied fields and for measuring critical exponents by alternative methods.

SUPPORTED BY U.S. Natl. Science Foundation

8.0056, THEORETICAL STUDIES IN MEDIUM- AND HIGH-ENERGY NUCLEAR PHYSICS
V. FRANCO, City University of New York, School of Liberal Arts, *Brooklyn, New York* 11210 (PHY75-06932 A01)

Theoretical research in nuclear physics which was initiated under NSF grant GP-16913A3 will be continued and enlarged. Specific topics in medium- and high-energy nuclear theory include: 1. Covariant wave equations and optical models for relativistic particles; 2. Covariant multiple scattering theory; 3. Application of the eikonal approximation in pion physics; 4. Scattering of hadrons and composite systems; 5. The role of isobars in nuclear scattering and nuclear structure calculations.

SUPPORTED BY U.S. Natl. Science Foundation

8.0057, PERCOLATION CONTROLLED TRANSPORT PROPERTIES IN SEMICONDUCTING GLASSES
D.G. AST, Cornell University, School of Engineering, *Ithaca, New York* 14850 (DMR75-03850)

This research will be a study of the compositional dependence of electronic transport properties in semiconducting glasses. Preliminary measurements by the principal investigator suggested that effective medium percolation theory correctly describes the compositional dependence of the conductivity in the As-Te system. This research has as its objectives: (a) to analyze in detail phenomena in the vicinity of the percolation threshold in order to discriminate between bond, correlated bond and domain percolation theories; (b) to separate carrier concentration from mobility effects by means of drift mobility measurements; (c) to investigate the relation between structure and applicability of percolation theory by varying the specimen preparation method (both evaporated and quenched materials); (d) to analyze recent conduction theories in terms of their compatibility with effective medium percolation theory; and (e) to extend the percolation approach to binary chalcogenide systems, in addition to amorphous AsxTel-x.

In addition to studying the electrical properties, an investigation of the structure will be undertaken by transmission electron microscopy to establish the presence or absence of phase separation.

SUPPORTED BY U.S. Natl. Science Foundation

8.0058, X-RAY DIFFRACTION AND SCATTERING IN CRYSTALLINE AND AMORPHOUS SOLIDS
B.W. BATTERMAN, Cornell University, School of Engineering, *Ithaca, New York* 14850 (DMR73-02384 A01)

The research program supported by NSF grant DMR-73-02384 will be continued. This includes a continuation of the studies of vibrational amplitudes, spatial distributions and anharmonic motion of valence electrons in silicon through the observation of the forbidden reflections. The unique properties of synchrotron radiation of the Cornell 12 GeV electron synchrotron will be used as the X-ray source for the diffraction experiments. The high intensity and high natural collimation of the beam should provide a unique opportunity to study these very weak reflections. The very low angle X-ray scattering of amorphous materials which have displayed unusual thermal properties at very low temperatures will also be investigated.

SUPPORTED BY U.S. Natl. Science Foundation

8.0059, IMPURITY-INDUCED ABSORPTION IN POTASSIM BROMIDE
R.O. POHL, Cornell University, School of Arts & Sciences, *Ithaca, New York* 14853 (DF900790; F19628-75-C-0177)

AF function - development of material components for high-energy infrared lasers. Deficiency - lack of acceptable materials for high- power laser application. Research - ultrapure alkali halide crystal growth and measurement of optical absorption characteristics. How research contributes - the research will identify atomic and molecular impurities which contribute to extrinsic absorption processes in alkali halide materials. These extrinsic absorption processes are currently believed to limit usefulness of these materials in high-power laser systems.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0060, LOW-ENERGY NUCLEAR PHYSICS AND WEAK INTERACTIONS
C. WU, Columbia University, School of Arts & Sciences, *New York, New York* 10027 (PHY76-01524)

Research will be conducted on a variety of problems using beta and gamma spectroscopy and the Mossbauer effect. Special attention will be given to (1) tests of conservation laws, (2) double gamma-emission as predicted by quantum electrodynamics but as yet unobserved, and (3) relative polarization of photons produced in positron annihilation.

Other nuclear orientation effects will be studied using a dilution refrigerator.

This work represents a continuation of that currently supported by Foundation grant MPS71-03314A05.

SUPPORTED BY U.S. Natl. Science Foundation

8.0061, RESEARCH IN EXPERIMENTAL AND THEORETICAL HIGH-ENERGY PHYSICS
R.L. COOL, Rockefeller University, Graduate School, *New York, New York* 10021 (E(11-1)-2232A)

The objective is to measure pi plus or minus, K plus or minus, and P plus or minus total cross sections on hydrogen and deuterium from 20 GeV to the highest energies available at the Fermi National Accelerator Laboratory. This new accelerator makes available for the first time beams of these particles above 20 GeV suitable for comprehensive, accurate measurements of this fundamental parameter. The measurements will test current theoretical ideas concerning the high-energy asymptotic behavior of strong interactions. A combination of scintillation counters, Cerenkov counters, and proportional wire chambers will be used to define and detect the interactions in targets of liquid hydrogen and deuterium. Measurements accurate to about two parts per thousand are envisioned. A search will be made for new long- lived particles.

RESULTS: Results of measurements at 50, 100, 150 and 200 GeV which have been published show that all total cross sections except for p increase with energy while the rate of decrease for p slows and becomes approximately constant. New data which extend the energy range confirm these results. A new beam is being prepared to extend the energy range to 400 GeV.

Part 1 of 8.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0062, ELECTRON-POSITRON PAIRS & ELECTRONS AND PI-MESONS WITH LARGE TRANSVERSE MOMENTUM PRODUCED IN P-P COLLISIONS (ABBREV)
R.L. COOL, Rockefeller University, Graduate School, *New York, New York* 10021 (E(11-1)-2232A)

Measurements of the energy of electrons (positrons) and photons near c.m.s. angles of 90 degrees allow a search for new massive particles which can decay via (e plus or minus nu), (e plus e minus), (e plus or minus gamma) and (neutral pion neutral pion). Two such particles have recently been discovered at SLAC and BNL. Their production in strong interactions and their decay properties will be investigated. Theoretical models also predict the existence of other fundamental particles in the ISR mass range, for example, the intermediate vector bosons which would mediate weak interactions. Measurement of the inclusive production cross section for neutral pion- mesons with large transverse momentum and of correlations with pi plus or minus and neutral pion mesons allows a study of the small-distance behavior of strong interactions.

RESULTS: Analysis and publication of Phase I is complete. Analysis of Phase II is essentially complete and the results are published or are being prepared for publication. The apparatus for Phase II is nearing completion and is scheduled for ISR installation in the spring and summer of 1976.

Part 4 of 8.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0063, EXPERIMENTAL STUDIES OF GRAVITATION - GRAVITATIONAL RADIATION
D.H. DOUGLASS, Univ. of Rochester, School of Arts & Sciences, *Rochester, New York* 14627 (PHY72-04755 A05)

Research initiated under NSF grant PHY-72-04755A03 will be continued. Effort has now shifted to construction of more sensitive antennae capable of detecting gravitational radiation from sources known to exist, such as supernovae explosions. High-Q single-crystal sapphire as a gravitational wave detector has the best ultimate sensitivity. The ultimate sensitivity of a 100Kg sapphire antenna at 10 to the minus 2nd power K is better than 10 to the minus 6th power GPU, for averaging time 1 sec, with perhaps several orders of magnitude of sensitivity in reserve. This is probably sufficient to see supernovae explosions in the Virgo cluster. This ultimate sensitivity is at least 10 times better than a 4800 Kg aluminum cylinder at the same temperature and for the same averaging time (and is about seven orders of magnitude improvement over a room-temperature antenna).

This year's program will initiate construction of a sapphire gravitational wave detector. In addition to having great sensitivity, it would be small in size, relatively inexpensive, and easy to operate.

SUPPORTED BY U.S. Natl. Science Foundation

8.0064, NUCLEAR STRUCTURE THEORY
J.B. FRENCH, Univ. of Rochester, School of Arts & Sciences, *Rochester, New York* 14627 (E(11-1)-2171)

Our research program is, broadly, the development and application of nuclear theory, including nuclear structure and nuclear reactions. This involves the development of new general theoretical methods, as well as the detailed examination of particular nuclei or nuclear reactions. We are working in the following areas: 1) Shell-model spectroscopy. Theory of the effective interaction and other aspects of the shell-model from the many-body point of view. 2) Spectral distribution methods in complex nuclei, including level densities and strength distribution, as well as general studies of nuclear symmetries and statistical behavior. 3) Interactions of high-energy particles with nuclei, including the theory of nuclear reactions of elementary particles, as well as nuclear-structure aspects of particle-removal reactions.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0065, EXPERIMENTAL STUDIES OF VALENCE INSTABILITIES 13428-P
R.D. PARKS, Univ. of Rochester, School of Arts & Sciences, *Rochester, New York* 14627 (DA0E9046; DAAG29 76 G0171)

To conduct experimental study of mixed valence and valence transitions in rare-earth systems. The research results will provide insights into a new class of materials which have the potential for eventual use as IR and FIR detectors.

Elastic properties of these rare-earth materials will be studied using a pulse echo overlap system which will permit the simultaneous measurement of both sound velocity and attenuation. Magnetic susceptibility will be measured as a function of temperature and an attempt made to correlate the stepwise changes at first-order transitions with the concomitant jumps in other quantities such as resistivity and volume. Calorimetric studies will be made in various temperature regimes as well as a study of the transport properties.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0066, HIGH-ENERGY PHOTOPRODUCTION STUDIES
E.H. THORNDIKE, Univ. of Rochester, School of Arts & Sciences, *Rochester, New York* 14627 (PHY75-02487 A01)

The Rochester group is: 1. Completing a study of photoproduction of vector mesons at Cornell gamma p yields omega N (940, 1470,....continuum) gamma p- yields rho delta (1238,....continuum) and similar processes on deuterium. A search for other states has also been made. 2. Measuring at Cornell the branching ratio of the radiative decays of vector mesons into pseudoscaler mesons. The experiment tests SU3 and vector meson dominance model predictions. 3. Planning an experiment on the coherent Coulomb dissociation of pions, kaons and antiprotons into two-body systems to be performed at Fermilab. This work is a continuation of that currently supported by Foundation grant number PHY750287.

SUPPORTED BY U.S. Natl. Science Foundation

8.0067, THEORETICAL PHYSICS
H. VANDAM, Univ. of North Carolina, School of Arts & Sciences, *Chapel Hill, North Carolina* 27514 (PHY76-14905)

Research on particle physics will concern the structure of hadrons. An approach growing out of 'Galilean sub-dynamics' and work by Gursey will be continued.

Research on quantum field theory will concern: I. A study of massive solutions as cooperative phenomena in massless Yang Mills theory. II. An effort to study the renormalizeability of the quantum theory of gravity, via interactions with other fields, using the method of super gauge symmetry. This work is a continuation of that currently supported by Foundation grant PHY73-05218AO1.

SUPPORTED BY U.S. Natl. Science Foundation

8.0068, PROPERTIES OF FLUID HELIUM NEAR CRITICAL POINTS
H. MEYER, Duke University, Graduate School, *Durham, North Carolina* 27706 (DMR75-22615)

This research continues and extends a research program presently supported by NSF Grant No. DMR71-01776. It is concerned with the variation, very near the gas-liquid critical point, of dielectric constant, magnetic susceptibility and the attenuation of ultrasound in He3, He4 and He3-He4 mixtures. Measurements will be made along the critical isochore, i.e., as a function of temperature, maintaining the volume constant at the critical volume. These quantities can be directly related to theories of critical-point behavior.

SUPPORTED BY U.S. Natl. Science Foundation

8.0069, PROPERTIES OF QUANTUM SOLIDS, IN PARTICULAR SOLID H2 AND D2
H. MEYER, Duke University, School of Arts & Sciences, *Durham, North Carolina* 27706 (DMR75-23681)

The research program on the properties of solid H2 and D2, previously supported by AROD and ONR will be continued. The main areas of research to be carried out are: a) A systematic study of the spectral density of rotational fluctuations in dilute ortho H2 at various densities by means of pulsed nuclear magnetic resonance. b) A systematic study of the diffusion motion in solid H2 under pressure. c) A search for the rotational order-disorder transition in solid D2 at para concentrations below 0.5 by means of NMR. d) A study of the crystalline field splitting in solid H2 under pressure. e) Observation of spectral densities of rotational fluctuations in dilute ortho H2 by means of high-resolution neutron scattering.

SUPPORTED BY U.S. Natl. Science Foundation

8.0070, THEORETICAL STUDIES ON VARIOUS COMPOSITE PARTICLE SYSTEMS
L.L. FOLDY, Case Western Reserve Univ., School of Science, *Cleveland, Ohio* 44106 (PHY76-00299)

Theoretical research on composite particle systems will be initiated. Particular topics to be investigated include: 1. Relativistic particle theories with direct interactions; 2. Multiple scattering theory; 3. Coulomb lattices; 4. Miscellaneous; a) Exchange current phenomena; b) Properties of some special classes of random matrices; c) Gauge-variant unitary transformations; d) Rescaling unitary transformations.

SUPPORTED BY U.S. Natl. Science Foundation

8.0071, THEORETICAL STUDIES IN NUCLEAR AND PARTICLE SCATTERINC

K.L. KOWALSKI, Case Western Reserve Univ., School of Science, *Cleveland, Ohio* 44106 (PHY74-02239 A02)

Research initiated under NSF grant MPS74-02239 AO1 will be continued. Theoretical investigation of several areas of nuclear and particle scattering will include:

1. Multiparticle Scattering - Formal and calculational investigation of the dynamics of the scattering of several strongly interacting particles (primarily nucleons and pions) with special attention to three-particle scattering problems.

2. Studies in Medium-Energy Theory - Study of several aspects of scattering theory (including nucleon-nucleus scattering, multiple- scattering theories, and theories of the optical potential), pion- nucleon and pion-nucleus scattering, and the nucleon-nucleon problem at medium energies.

3. Development of New Methods in the Theory of Nuclear Reactions - Formal and calculational investigation having the goal of developing theoretical tools for dealing with the complex many-body aspects of nuclear reactions including elastic scattering, transfer reactions, and radioactive decay.

SUPPORTED BY U.S. Natl. Science Foundation

8.0072, NUCLEAR PHYSICS RESEARCH WITH A 7 MV VAN DE GRAAFF ACCELERATOR

H.J. HAUSMAN, Ohio State University, School of Math. & Phys. Scis., *Columbus, Ohio* 43210 (PHY74-08524 A02)

The research program at The Ohio State University Van de Graaff Laboratory covers a broad spectrum of experiments in nuclear spectroscopy, nuclear reaction mechanisms, and related areas. Major interests include investigations of polarization phenomena, radiative capture reactions, reaction-mechanism-independent spectroscopy of unbound nuclear states, the structure of 1f-2p nuclei, reactions of astrophysical interest, and atomic physics through X-ray production measurements. The accelerator, recently upgraded to extend its energy range and provide polarized-beam capabilities, is supported by extensive physical and service facilities.

This work is a continuation of that currently supported by Foundation grant MPS74-08524 A01.

SUPPORTED BY U.S. Natl. Science Foundation

8.0073, HIGH-ENERGY PHYSICS

T.A. ROMANOWSKI, Ohio State University, School of Math. & Phys. Scis., *Columbus, Ohio* 43210 (E(11-1)-1545)

In the coming year analysis of the data from the following experiments will continue: 'A High Statistics Study of omega zero Production' E-337 (ZGS), 'A High Statistics Measurement of rho-omega zero Interference in pi N yields positive pion negative pion pi ON' E- 380 (ZGS), 'A Determination of A and R Polarization Parameters of Inclusively Produced lambda's with a 6 GeV/c Polarized Proton Beam' E- 336 (ZGS), 'The Neutron-Proton Charge Exchange Cross-section for Incident Momenta 50-300 GeV/c' E-12 (FERMILAB). 'A Search for Narrow High Mass Resonance Using Mass Focusing Spectrometer' E-366 (FERMILAB). It is expected that more data will be collected for E-380 and a search for higher mass neutral mesons will be pursued with that apparatus. The spectrometer to study 'Beta Decays of Polarized sigma minus 'E-347 (ZGS) will be taking data. The study of polarization parameters of inclusively produced lambda's with polarized protons will be extended to 12 GeV/c. The search for new particles may continue or other more conventional physics will be undertaken with the spectrometer at Fermilab which is now used for E-366.

Improvements to increase data-taking capabilities of the two on- line computer systems PDP 15 and SPEC 16 will continue.

Development of a drift chamber system will continue.

Theoretical program: The theoretical investigation proposed for the coming year can be summarized broadly as follows: Study of the decay and production of psi and psi' mesons, work on the supersymmetry which incorporates bosons and fermions, study of phase transitions in dense nuclear matter, study of Reggeon field theory, investigation of hadron production in high-energy collisions, study of a parton-gluon model and of the photoproduction of psi meson.

RESULTS: Results from our research in experimental and theoretical high-energy physics program were published and a list of publications is appended.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0074, ULTRASONIC INVESTIGATION OF VERY HIGH DENSITY GASES

S.E. BABB, Univ. of Oklahoma, Graduate School, *Norman, Oklahoma* 73069 (ENG75-21641)

The overall objective of the entire research program is to increase our understanding of the basic energies of intermolecular interactions, including multibody forces. In this specific project, ultrasonic techniques will be used to study very dense gaseous systems. The experimental portion will determine the density as a function of pressure and temperature by studying the propagation of ultrasonic waves through the medium. The pressure will be restricted to the very high pressure region, i.e., that above 20 kbars, where other methods become unworkable. The gases to be studied include N2, He, Ne, C3H6, C3H8 and hopefully H2 and D2. This work necessitates development of procedure of handling gases under these conditions, and will also produce some information on melting curves of these materials. The computational work is twofold. One aim is to complete a very careful study of the current pertubative approaches to the equation of state at very high densities. The other is to finish a detailed examination of the Prigogine-Nicolis-Misguich theory of dense gas transport plus various derivative versions of this theory and also the Rice-Allnatt theory. This work uses a data base of computed radial distribution functions developed earlier. These computations can evaluate the basic understanding of the processes involved in dense gas transport phenomena.

SUPPORTED BY U.S. Natl. Science Foundation

8.0075, THERMOLUMINESCENCE STUDIES OF RADIATION-INDUCED DEFECTS IN POTASSIUM MAGNESIUM FLUORIDE MONOCRYSTALS

E.E. KOHNKE, Okla. St. Univ., School of Arts & Sciences, *Stillwater, Oklahoma* 74075

Thermoluminescent glow curves for impurity-doped and radiation- damaged $KMgF_3$ are being obtained in a study of F-centers and Vk centers.

SUPPORTED BY Oklahoma State Government - Oklahoma City

8.0076, PHONON INTERACTIONS WITH STRONGLY COUPLED IMPURITIES IN CRYSTALLINE SOLIDS

J.N. LANGE, Okla. St. Univ., School of Arts & Sciences, *Stillwater, Oklahoma* 74075 (DMR76-19594)

The experimental investigation previously supported by NSF Grant DMR73-07601 will be continued. This investigation will study the behavior of strongly coupled transition-metal substitutional impurities (i.e., Cr2 ion, Fe2 ion) in insulating crystals (MgO, CaO, $KMgF_3$). The behavior of these impurities will be monitored by measurements of the hypersonic attenuation (greater than 10 to the 9th power Hz) using the techniques of microwave acoustics. The temperature dependence of the attenuation in zero magnetic field will be used to determine the presence of any relaxation absorption due to a particular impurity. Determinations of acoustic paramagnetic resonance (APR) spectra will be used to yield the effective 'g' factor anisotropy for the paramagnetic states of the molecular cluster. The temperature dependence of the paramagnetic resonance peaks will be measured to determine the population of a particular energy level due to the lattice thermal phonon excitations, which is used to estimate energy-level separations. The Jahn-Teller tunneling splitting and the spin-orbit splitting energy have been determined for the chromous ion in MgO. The values indicate a more extreme Jahn-Teller dynamic limit than previously assumed. The effects of bonding will be investigated by similar measurements in another host crystal with approximately the same octahedral site but with a different anion.

SUPPORTED BY U.S. Natl. Science Foundation

8.0077, ATOMIC INNER-SHELL TRANSITIONS 12838-P
B. CRASEMANN, Univ. of Oregon, School of Liberal Arts, *Eugene, Oregon* 97401 (DA0E8979; DAHC04-74-G-0021)

To study L- and M-shell fluorescence yields and Coster-Kronig transition probabilities, and to study photoelectric cross sections in H2 and He. The results should show an obvious potential for use in the nondestructive testing of materials containing trace impurities. As such, the research should have an impact on various electronic devices of import to the Army (semiconductors).

Calculations of L2- and L3-subshell fluorescence yields will be made. Vacancy distributions in the M-subshells will be calculated. M X-ray intensity measurements will be made to derive M-shell fluorescence yields. Photoelectric cross sections of H2 and He will be made in the 3- 10 kev X-ray region.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0078, THEORY OF MANY-PARTICLE SYSTEMS
M.D. GIRARDEAU, Univ. of Oregon, School of Liberal Arts, *Eugene, Oregon* 97401 (DMR72-03211 A01)

Work will continue on the construction and applications of second quantization representations for systems of composite particles. An investigation to understand the connection between quantization of circulation and metastability of superfluid flow in microscopic detail will be started. The model system consists of an ideal Bose gas initially in rotation with respect to a cylindrical container at rest. The cylinder is assured to have a local roughness in this model of a nonequilibrium condition in which a more correct criterion of stability than that by Landau will be sought.

SUPPORTED BY U.S. Natl. Science Foundation

8.0079, JOINT THEORETICAL PROGRAM WITH EMPHASIS IN STATISTICAL MECHANICS AND MOLECULAR PROPERTIES
S.Y. LARSEN, Temple University, School of Liberal Arts, *Philadelphia, Pennsylvania* 19122 (INT73-07411 A03)

This program is a continuation and expansion of cooperative research that has been underway for several years between Dr. Sigurd Larsen and his associates at Temple University, and their collaborators at the Instituto Mexicano del Petroleo. Investigations have been pursued in several areas of chemical physics involving, in particular, statistical mechanics and quantum theory. One area in which research is to be continued under this award is the study and calculation of virial and transport coefficients involving the collisions of molecules with structure and nonspherical forces (two particles), and in addition with three or more particles (using new techniques involving hyperspherical harmonics). As experience is developed with the new methods, it is hoped to use them to calculate rearrangement collisions. The second effort, representing a new area of interest, is aimed at developing a genuine statistical mechanical treatment of chemical reactions and their implications on the transport behavior of chemically reacting solutions. As a basic concept the idea of 'independent components' will be utilized, which takes into account the constraints imposed by the reactive collision. Near equilibrium at least, the independent components form a natural set of conserved variables in terms of which to make use of the theory of linear response. There is considerable complementarity (if not outright overlap) between aspects of these two lines of research; it is hoped that progress in one area will often be useful in the other investigations.

SUPPORTED BY U.S. Natl. Science Foundation

8.0080, ELECTRON SPECTROSCOPY OF SOLID SURFACES
E.W. PLUMMER, Univ. of Pennsylvania, School of Arts & Sciences, *Philadelphia, Pennsylvania* 19104 (DMR75-09491 A01)

Major emphasis of this program, previously supported by NSF grant DMR75-09491, will be on the elucidation of intrinsic surface states and surface resonances on clean metal surfaces. The experimental program will utilize field and angular resolved photoemission spectroscopies and will be closely coupled with theoretical calculations. The experiments will be concentrated on surface resonances on 100 faces of W, Mo and Cr and on 111 faces of Cu, Au and Ag.

SUPPORTED BY U.S. Natl. Science Foundation

8.0081, THEORETICAL PHYSICS
L.S. KISSLINGER, Carnegie Mellon University, Graduate School, *Pittsburgh, Pennsylvania* 15213 (PHY75-22555)

Theoretical research in nuclear physics initiated under NSF grant MPS73-05010A01 will be continued. Specific topics to be investigated include: 1. Nuclear structures at high and low spin (Sorensen); 2. Equation of motion method for 28 less than z less than 50 nuclei(Kisslinger); 3. Pion-nucleus elastic scattering and reactions. Multiple scattering theory (Kisslinger); 4. Doorway-isobar model (Kisslinger); 5. Baryon resonance components of nuclei (Kisslinger); 6. The (K negative, negative pion) reactions on nuclei (Kisslinger); 7. Spectroscopic factors from analytic properties (Kisslinger).

SUPPORTED BY U.S. Natl. Science Foundation

8.0082, THEORETICAL STUDIES OF NUCLEAR STRUCTURE AND NUCLEAR REACTIONS
N. AUSTERN, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (PHY75-01397 A01)

SUPPORTED BY U.S. Natl. Science Foundation

8.0083, PARTICLE RESONANCES
E.J. ENGELS, Univ. of Pittsburgh, School of Arts & Sciences, *Pittsburgh, Pennsylvania* 15260 (PHY72-04856 A03)

This three-part program consists of the following sections: 1. Gamma - production in hyperon - proton collisions. This experiment was performed in the Brookhaven hyperon beam in collaboration with groups from the University of Massachusetts and BNL. Data which are now being analyzed will give information on the spectrum of gamma-resonances. 2. Triple Bond - leptonic decays. This experiment which is presently in a running phase is being performed in the Brookhaven hyperon beam. Information from the experiment is expected to elucidate knowledge about weak interactions, SU3 and Cabibbo theory. 3. Pion - Electron scattering at a few hundred GeV. This experiment, being performed at Fermilab, in collaboration with groups from Notre Dame, UCLA, and Fermilab in the USA and Dubna in the USSR, will yield information on the charge distribution of the charged pi meson.

This work is a continuation of that currently supported by Foundation grant number GP-34633, Amendment No. 2.

SUPPORTED BY U.S. Natl. Science Foundation

8.0084, NUCLEAR STRUCTURE STUDIES USING PHOTONS
F.R. METZGER, Franklin Inst. of State of Pa., *Swarthmore, Pennsylvania* 19081 (PHY71-03444 A04)

This work is a continuation of that currently supported by Foundation grant MPS71-03444 AO3. The resonant scattering of gamma rays by bound states of nuclei will be studied, using electron bremsstrahlung as the photon source. The nuclear properties derived from these experiments will be used to test nuclear models over the entire range of stable nuclei. Of particular interest for the immediate future are studies of the concentration of electric dipole strength in vibrational nuclei, the distribution of E1 and M1 strength in deformed nuclei, studies of radiative width in the A equals 90 region, and accurate determinations of the strength of corresponding transitions in mirror nuclei.

SUPPORTED BY U.S. Natl. Science Foundation

8.0085, ELECTRONIC STRUCTURE AND STABILITY OF METALLIC GLASSES 13723-P

J. TAUC, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DA0E9132; DAAG29 76 G0221)

Develop theoretical and experimental understanding of the influence of the electron gas on the stability of metallic glasses. Relevance - metallic glasses prepared by fast quenching of some alloys have many valuable properties of technological importance. Among these outstanding characteristics are high strength, ductility, corrosion resistance and simplicity of production. Increased understanding of the mechanisms which control the stability of these and other systems is crucial to the ultimate exploitation of their potential.

A test of the basic assumptions of an electron theory of metallic glasses will be made by a variety of experiments including ultraviolet photoemission, optical properties, magnetic susceptibility, transport properties and inelastic neutron scattering. An attempt will be made to extend the present theory to other classes of alloy systems.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0086, OPTICAL STUDIES OF ELECTRONIC STATES, VIBRATIONS AND RELAXATION PROCESSES IN AMORPHOUS SYSTEMS

J. TAUC, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DMR76-17443)

Research on amorphous and liquid semiconductors previously supported by NSF grant DMR71-01814 will be continued. Work in the electronic states in the gap of amorphous and liquid semiconductors, in particular on the absorption tails below the gap in amorphous and liquid As 2S3 doped with various impurities such as Fe, will be continued. Experimental and theoretical studies of the temperature dependence of the Raman spectra, in particular on the changes that occur when one passes through the glass-transition, will be carried out. The previous work will be extended to include organic glass-formers. The Raman spectra of samples in the form of optical waveguides (fibers or thin films) will be measured with the aim of studying vibrations at the interface. Studies of fast relaxation processes in liquids and glasses in the picosecond range will be initiated. For this work a picosecond dye-laser system will be set up. The first experiment will deal with the relaxation of a hot vibrational mode over a broad temperature range that includes the glass transition.

SUPPORTED BY U.S. Natl. Science Foundation

8.0087, NEUTRON PHYSICS RESEARCH - ORELA

J.A. HARVEY, U.S. Energy Res. & Dev. Admin., Oak Ridge National Lab., *Oak Ridge, Tennessee* 37831

DESCRIPTION: The purpose of this program of neutron time-of-flight spectroscopy is to measure neutron cross sections of nuclides from neutron energies of approximately 1 electron volt up to energies of approximately 10 MeV. Single-parameter experiments, such as measurements of the total, fission, capture, scattering, and (n, alpha) cross sections of nuclides, can be analyzed to give the parameters of the individual resonances, and average properties of the resonances where resonances cannot be resolved. Total cross-section measurements were completed on the isotopes of Si, S, K, Ca, Ti, Fe and Pb up to approximately 500 keV. Below approximately 50 keV the measurements are made with a Li-6 glass scintillator; above approximately 20 keV a Ne-110 detector is used. The analysis for a few of the nuclides, K-41, Fe-57 and Fe-54, is nearly complete and the analysis of the others is in progress. Total cross-section measurements on Pu-239 were extended up to MeV.

BIBLIOGRAPHIC REFERENCES: (1) W.M. Good, J.A. Harvey, and N.W. Hill, 'Neutron Resonances in 39K and 41K,' Bulletin of American Physical Society 18, 1401 (October 1973) (Bloomington, Indiana, APS Meeting, November 1-3, 1973); (2) J.A. Harvey, G.D. James, N.W. Hill, and R. Schindler, 'Neutron Total Cross Section of U-234,' Bulletin of American Physical Society 19, 595 (April 1974) (Washington, D.C., APS Meeting, April 22-25, 1974).

ADDENDA: Estimated calendar year funding reported as 1974 $625,000, 1975 $528,000.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0088, EXPERIMENTAL STUDY OF STRONG CURRENT-DRIVEN PLASMA TURBULENCE

K.W. GENTLE, Univ. of Texas, School of Arts & Sciences, *Austin, Texas* 78712 (PHY75-21395 A01)

Studies of strong current-driven plasma turbulence will be continued. A high electric field, almost constant in time, is applied to a toroidal plasma in a magnetic field. Initial experiments have shown that the plasma is characterized by a resistance within the resolution of the voltage-current measurements. The phenomenological resistivity and particle heating will be examined in greater detail, including incremental changes in applied field to determine the response of the developed turbulent state. A spectrum of high-frequency waves appears in the plasma with the onset of turbulent resistivity. The major effort of this experiment will be directed to characterizing these waves and the nonlinear mechanism whereby they give rise to a resistance.

This work is a continuation of that currently supported by Foundation grant PHY75-21395.

SUPPORTED BY U.S. Natl. Science Foundation

8.0089, INTERMEDIATE-ENERGY NUCLEAR PHYSICS STUDIES

G.C. PHILLIPS, Rice University, Graduate School, *Houston, Texas* 77001 (E(40-1)-1316)

The proposed research has the objective of carrying out experimental studies of nuclear structure and nuclear reaction mechanisms at intermediate energies. Studies of pion small-angle scattering (E-80), proton scattering and reaction (E-81), and pion scattering and reactions (E-83) will be carried out at LAMPF. The principal equipment to be used will be the Rice University Portable Laboratory which houses the PDP/11-45 computer, electronics, multiwire and scintillation counters.

RESULTS: Research under this contract since 1968 has resulted in 10 M.A. theses and 4 Ph.D.'s and the group has published 34 papers.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0090, CALCULATIONS OF DEFECT INTERACTIONS IN NONTRANSITION METALS 13061-PP

R.E. BEISSNER, Southwest Research Institute, *San Antonio, Texas* 78228 (DA0E9108; DAAG29 76 C 0031)

To develop the theory of interatomic potentials of metals involving defects, including lattice distortion and disorder, with the goal of impacting studies of realistic defect structures such as point defects, defect pairs, stacking faults, and grain boundaries. This research is directly relevant to ongoing programs at AMMRC in interatomic potentials with applications to computer simulation of defect structures. These defects affect thermomechanical, static and dynamic properties of metals and alloys, failure and strengthening mechanisms and corrosion.

The Green's function method of many-body theory of theoretical physics will be the main tool, supplemented by pseudopotential theory of solid-state physics. Long-range interactions in non-transition metals will be taken into account. Accurate calculations of screening charge distributions around a point defect in aluminum will be performed and compared with NMR experimental data.

ADDENDA: SUPPORTING AGENCY ADDRESS IS: DARCOM Army Research Office, Box 12211, Research Triangle Park, N.C. 27709

SUPPORTED BY U.S. Dept. of Defense - Army

8.0091, CRYSTAL GROWTH FROM VAPORS

F. ROSENBERGER, Univ. of Utah, School of Letters & Science, *Salt Lake City, Utah* 84112 (DMR75-03175)

Chemical vapor deposition (CVD) and physical vapor deposition (PVD) will be used to study transport mechanisms of vapor species in crystal growth processes. Crystal growth rates

will be determined and related to transport kinetics and/or interface kinetics at the growing crystal and the source. Studies will be made on Zn, I2, CdS and CdTe, materials which have reasonably well known vapor viscosities and well characterized vapor composition. Growth rates and composition profiles will be measured using closed tube growth conditions that are diffusionless, diffusive, or convective-diffusive. Steady-state rates resulting from diffusionless transport will be measured in cylindrical ampoules as a function of tube diameter, tube length, and temperature difference between source and crystal, using a long-focal-length microscope and weight-change measurements. Thermal diffusion studies will be made in open tube systems to examine non-equilibrium phenomena. Diffusive-convective transport studies will include varying the ampoule pressure and orientation wih respect to gravity. Chemical characterization will be undertaken by an atomic absorption spectrophotometer with a flameless atomizer.

SUPPORTED BY U.S. Natl. Science Foundation

8.0092, PROBLEMS IN ELEMENTARY PARTICLE THEORY
V.L. TEPLITZ, Virginia Poly. Inst. & St. U., School of Arts & Sciences, *Blacksburg, Virginia* 24061 (PHY76-11349)

Theoretical work will concentrate on analyses of the reaction piN yields pi piN.

SUPPORTED BY U.S. Natl. Science Foundation

8.0093, SURFACE STUDIES IN SOLIDS
V. CELLI, Univ. of Virginia, School of Arts & Sciences, *Charlottesville, Virginia* 22903 (DMR76-17375)

Research previously supported under grant DMR72-03091 will be continued and extended. The general thrust of the research is in the development of the theory of scattering from a rough or periodic surface and of the bound and resonant states on such a surface. The theory has applications to a wide variety of surface phenomena, including the scattering of atoms and molecules, the scattering and diffraction of electromagnetic radiation and the electronic structure of surface kinks and steps. Particular emphasis will be on: (a) the application of the extinction theorems of optics to the calculation of optical and electronic properties, with application to semiconductor surfaces, and (b) the use of semiclassical path-integral methods in the theory of surface scattering into resonant surface states and in a multichannel theory of reactive scattering of atoms and molecules.

SUPPORTED BY U.S. Natl. Science Foundation

8.0094, DETERMINATION OF NEWTON'S GRAVITATIONAL CONSTANT, G
R.A. LOWRY, Univ. of Virginia, School of Engin. & Appl. Sci., *Charlottesville, Virginia* 22903 (MPS72-04828 A04)

This work is a continuation of that currently supported by Foundation grant MPS-04828, Amendment No. 3.

A design and systems study and preliminary experiments will be made to explore a method to measure (or set a limit on) any relative time variation of the Newtonian Gravitational Constant G. The present technique for measuring the absolute value of G using a rotating table will serve as a basis for the new experiment.

SUPPORTED BY U.S. Natl. Science Foundation

8.0095, POSITIVE MUON PRECESSION IN SOLIDS
W.J. KOSSLER, Coll. of William & Mary, School of Arts & Sciences, *Williamsburg, Virginia* 23185 (DMR75-10193)

The decay of polarized positive muons in solids will be utilized to study several solid-state problems including: Nuclear dipolar interactions and muon diffusion in Al, In, Cu and V; Muon cross relaxation in Al2O3; Critical fluctuations in antiferromagnets, mainly Cr; Search for muon precession in magnetic insulators, and, depolarization and diffusion in elemental magnetic materials including transition metals and rare earths.

SUPPORTED BY U.S. Natl. Science Foundation

8.0096, DIFFRACTIVE DISSOCIATION AT HIGH ENERGIES
H.J. LUBATTI, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (PHY72-05042 A03)

The experimental program centers around bubble-chamber exposures at Fermilab and Stanford Linear Accelerator Center (SLAC) and a streamer- chamber experiment at Fermilab. 1. An exposure of SLAC 82-inch bubble chamber with a deuterium foil, exposed to 15 GeV/c pi minus mesons, is used to study the diffractive dissociation of the pion and inclusive particle spectra. 2. The Fermilab 30-inch hydrogen bubble chamber, exposed to pi minus beams of 200 and 400 GeV/c momentum, will be used to observe high-energy pion interactions - double scattering within the deuterium nucleus, a search for possible unknown particles and a measurement of neutral V's have been completed and a study of rapidity distributions is in progress. 3. An anti-neutrino experiment with the Fermilab 15-inch bubble chamber filled with a heavy liquid is designed to study neutral currents, and final states with one and two muons. 4. A stuay of pion dissociation off He with a streamer chamber at Fermilab is scheduled. 5. A particle search in a streamer chamber at Fermilab is sensitive to particles which decay semileptonically into lambda, mu and neutrino.

This work is a continuation of that currently supported by Foundation grant PHY72-05042A02.

SUPPORTED BY U.S. Natl. Science Foundation

8.0097, THEORETICAL STUDIES OF ADSORBED MONOLAYERS
M. SCHICK, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (DMR73-02582 A02)

The research program supported by NSF Grant DMR-7302582 will be continued. The work is composed of five theoretical problems, four of which are addressed to questions raised by recent studies of monolayers of helium adsorbed on graphite. The object of these studies is to provide first, an improved virial expansion description of the low- density gases of both isotopes at high temperatures; second, a complete description of the adsorbed He3 system at low densities at all temperatures; third, a prediction of the expected behavior of the two- dimensional He4 liquid at low temperatures; fourth, an improved calculation of the phase diagram of both isotopes in the region of spatial ordering. Results which are applicable to bulk systems are also anticipated. These include an explanation of the origin of the specific heat anomaly which is observed in liquid He3 at two-tenths of a degree Kelvin.

SUPPORTED BY U.S. Natl. Science Foundation

8.0098, RESEARCH IN NUCLEAR PHYSICS AND ATOMIC COLLISIONS
H.T. RICHARDS, Univ. of Wisconsin, School of Letters & Science, *Madison, Wisconsin* 53706 (E(11-1)-GEN-7 'A')

OBJECTIVE: Understanding of nuclear forces and structure of nuclei, improvement of ion sources.

SCIENTIFIC BACKGROUND: The accurate measurement of scattering and reaction cross sections, especially with polarized projectiles, provides the data from which inferences on nuclear forces and structure must come.

PROCEDURE: Test objects and agents: An electrostatic tandem accelerator (plus polarized ion source) provides the high-velocity projectiles for probing the selected targets.

Part 1 of 2.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0099, PARTIAL PRESSURES OVER SEMICONDUCTORS AND MELTS, COMPUTER ANALYSIS OF SEMICONDUCTOR PHASE DIAGRAM AND THERMODYNAMIC DATA (ABBREV)
R.F. BREBRICK, Marquette University, School of Engineering, *Milwaukee, Wisconsin* 53233 (DMR75-09332)

Experimental and theoretical research will be performed on thermodynamics and phase equilibria of semiconductor compounds. Experiments will include optical density measurements of the vapor coexisting with various semiconductors at high tem-

peratures. The arsenic and Zn - Se systems will be studied, and the results will be analyzed to give partial pressures of the vapor species as a function of temperature. The activities of Zn and Se along the ZnSe(s) liquidus and the enthalpy and entropy of formation of ZnSe(s) will be obtained. Theoretical studies will consist of simultaneous computer fits to the liquidus lines and other thermodynamic properties for various systems in which semiconductor compounds appear.

This is a continuation of work supported by DMR7101787.

SUPPORTED BY U.S. Natl: Science Foundation

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, PHOTOELECTRIC PHOTOMETRY OF YOUNG CLASSICAL CEPHEIDS

G.V. COYNE, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (MPS73-04395)

Concentrated photoelectric observations of Classical Cepheids will be carried out over a period of two years in order to obtain distance moduli accurate to 0.2 mag, using the period-luminosity-color relationship. These objects are extremely valuable for the delineation of spiral arms and young material in the galaxy. The Cepheids are extremely important in the delineation of the so-called '4 kpc' arm. Three of the Cepheids in Cygnus-Vulpecula are at distances greater than 3 kpc and may be the first optical objects to indicate the curvature of the Cygnus arm towards lower longitudes.

The observations will be made using the four telescopes with an aperture larger than 40 inches available at the University of Arizona.

SUPPORTED BY U.S. Natl. Science Foundation

10.0002, GENERAL RELATIVITY AND COSMOLOGY

R.K. SACHS, Univ. of California, School of Letters & Science, *Berkeley, California* 94720 (PHY76-08961)

Theoretical research in General Relativity initiated under NSF grant PHY71-03021 A04 will be continued. Specific topics to be investigated include: 1. Study of the large-scale structure of the universe using the methods of homogeneous isotropic turbulence theory. The study will be based on the observation that the universe shows large local deviations from homogeneity and isotropy but, in a statistical sense, is homogeneous and isotropic over sufficiently large distances. 2. Study of determinism and predictability within the framework of general relativity. Strictly non-quantum cosmological models have indicated that only under very special assumptions can one systematically account for the overall success of our models in prediction. Whether assuming quantum matter models (but non-quantum space times) ameliorates the situation will be investigated.

SUPPORTED BY U.S. Natl. Science Foundation

10.0003, MILLIMETER-WAVELENGTH STUDIES OF INTERSTELLAR MOLECULES

W.J. WILSON, Aerospace Corporation, *Los Angeles, California* 90045 (MPS73-04554)

The Aerospace Corporation has a millimeter-wave spectral-line receiver for use with the Aerospace 15-foot antenna. This new capability for studies of millimeter-wavelength radiation from interstellar molecules will provide the ability to make important observations. Information on chemical and isotope abundances, kinematics, and spatial distributions in the general interstellar medium, in dust clouds, and in stellar atmospheres and circumstellar envelopes will be achieved. Approximately 120 days (1900 hours) per year will be made available for guest investigators.

SUPPORTED BY U.S. Natl. Science Foundation

10.0004, ASTRONOMY RESEARCH AT THE OWENS VALLEY RADIO OBSERVATORY

A.T. MOFFET, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (AST73-04677 A03)

Extragalactic research to be supported will include studies of the kinematics, molecular content and gas distribution of nearby galaxies using various spectral lines. Using very long baseline (VLB) techniques, compact sources will be mapped and variations in shape and intensity of compact sources will be monitored. Inclusion of phase information in VLB observations will be emphasized. A survey of sources at 3.7 cm wavelength will be continued.

Within our galaxy, various spectral lines will be used to study the kinematics of dense clouds, regions of star formation and certain stellar envelopes. The relation between H O and OH masers and the infrared intensity of the associated stars will be investigated.

The nature of the rings of Saturn and of the Moon's crust will be studied with the aid of high-resolution mapping. A new interference polarimeter will be used to examine the small-scale structure of solar flares. Research will be continued on programming systems for control of telescopes and instruments, as will development of feeds, receivers, antennas and auxiliary instruments.

This is a continuation of research previously supported by NSF grant AST 73-04667.

SUPPORTED BY U.S. Natl. Science Foundation

10.0005, ELECTRONOGRAPHIC ASTRONOMICAL PHOTOMETRY

M.F. WALKER, Univ. of California, Lick Observatory, *San Jose, California* 95060 (AST75-14347)

The following programs in astronomical electronographic photometry will be carried out: Completion of reduction of the electronographic observations of stars in clusters associated with the Magellanic Clouds, which were obtained with the Spectracon and the Cerro Tololo 60-inch reflctor in 1968-1969. Continuation of current observing programs at the prime focus of the 120-inch reflector and the Cassegrain focus of the 24-inch reflector of the Lick Observatory. These programs will include: UBV photometry of stars in galactic globular clusters and local group galaxies, down to at least V equals 22; a search for the optical pulses of radio pulsars; observations of the faint outer parts of extragalactic nebulae and of luminous connections between galaxies of greatly different redshift.

SUPPORTED BY U.S. Natl. Science Foundation

10.0006, THEORY OF PLASMA WAVES, ELECTRON STREAMS, AND RADIO-WAVE EMISSION DURING TYPE III SOLAR RADIO BURSTS

M.V. GOLDMAN, Univ. of Colorado, School of Arts & Sciences, *Boulder, Colorado* 80302 (ATM76-14275)

Solar flares are capable of accelerating electrons to high energies and expelling them from the corona so that they may propagate to the orbit of the earth and beyond. The electrons emit Type III radio bursts which are detected at earth; the exact nature of these radio bursts is not well understood. The purpose of this grant is to gain a theoretical understanding of the following phenomena associated with Type III bursts: a) The propagation of electron streams from the sun to the earth and beyond, with particular attention to the reasons for their observed stability and eventual isotropization. b) The evolution of plasma-wave turbulence excited by the electron streams at each point from the lower corona to the earth's orbit and beyond. c) The radio-wave emission produced by the wave spectrum, with emphasis on possible changes in the character of the emission as a function of the magnitude of the electron stream flux or other parameters of the emitting region.

Progress in these areas will be important to solar terrestrial relations in terms of atmospheric disturbances produced by solar electron bombardment.

SUPPORTED BY U.S. Natl. Science Foundation

10.0007, SOLAR ACTIVITY AND LARGE-SCALE CIRCULATION OF THE EARTH'S ATMOSPHERE
W.O. ROBERTS, Univ. of Colorado, Graduate School, *Boulder, Colorado* 80302 (DES75-06540)

Studies of the short-term connections of strong solar and/or geomagnetic activity with the circulation of the lower stratosphere and upper troposphere will be conducted. The purpose will not be to seek further to build the evidence for the reality of these connections, but rather to try to make critical tests between the different working hypotheses that have been advanced to explain the observed correlations. An attempt will be made to examine why different workers in this field have found somewhat different 'lag times' between solar or geomagnetic activity events and the presumably related meteorological phenomena.

SUPPORTED BY U.S. Natl. Science Foundation

10.0008, SOLAR, INTERPLANETARY AND MAGNETOSPHERIC STUDIES WITH ENERGETIC PARTICLES
J.A. SIMPSON, Univ. of Chicago, Graduate School, *Chicago, Illinois* 60637 (ATM75-20407 A01)

The central themes of the research supported in this grant are: a) the search for the basic charged-particle acceleration mechanisms on the Sun, b) studies on the physics of the heliosphere and interplanetary medium which relate or couple solar high-energy phenomena to energetic processes in planetary magnetospheres, and c) the isotopic and chemical composition of the source material accelerated in solar flares.

These broad themes translate into these specific goals: 1. Experimental and theoretical studies of the solar flare mechanism, with the main emphasis based on the analysis of the isotopic composition of hydrogen and helium and the differential energy spectra of these isotopes; 2. Solar particle propagation in the corona and interplanetary space based on observations from spacecraft distributed throughout the inner solar system; 3. Studies of the eleven-year changes in the heliosphere based upon the solar modulation of galactic cosmic rays and the propagation of solar flare particles; 4. Operation of the Climax and Huancayo Neutron Intensity Monitor Stations.

SUPPORTED BY U.S. Natl. Science Foundation

10.0009, INVESTIGATIONS OF GALACTIC STRUCTURE
F.J. KERR, Univ. of Maryland, School of Arts & Sciences, *College Park, Maryland* 20742 (AST75-09734 A01)

The research under investigation includes topics on various aspects of galactic structure. Radio astronomical telescopes are used to gather data which upon reduction broadens our understanding of the structure of our Milky Way galaxy. A survey of the Southern Milky Way at a wavelength of 21-cm will be completed. A study of the gas-to-dust ratio in the Coalsack region of the Southern Milky Way will be made. Optical extinction values will be determined, too. A search will be made for neutral hydrogen in selected globular star clusters. The gas-to-dust ratio in the disk of our galaxy will be studied. Radio observations at a wavelength of 21-cm will be made of the central region of our galaxy. The apparent tilt of the neutral hydrogen distribution in the nuclear disk and in the surrounding region will be studied. The radio nature of the OH stars will be investigated.

Galactic models will be developed, based on the density-wave theory and comparisons with 21-cm wavelength data.

SUPPORTED BY U.S. Natl. Science Foundation

10.0010, PLASMA PHYSICS OF SOLAR ENERGETIC PARTICLES
D.G. WENTZEL, Univ. of Maryland, School of Arts & Sciences, *College Park, Maryland* 20742 (DES74-20834)

Numerous plasma processes in the solar corona control the rate at which energetic electrons can escape to the solar atmosphere, causing X- ray bursts, or escape into the solar wind, to be observed near the Earth. Simple estimates show that whistler waves grow so rapidly in a region of magnetically trapped electrons and scatter the electrons so efficiently that the electrons can be trapped for at most a few seconds. This grant studies the relation of these waves to radio emissions from the sun.

SUPPORTED BY U.S. Natl. Science Foundation

10.0011, EVOLUTION OF LOW-MASS STARS
P.G. GROSS, Case Western Reserve Univ., Graduate School, *Cleveland, Ohio* 44106 (AST76-14759)

A series of stellar models have been computed which cover all possible ranges of the physical parameters for low-mass stars. The stellar models are sets of card images stored on computer disks, giving the behavior of the physical variables for the interiors of stars at critical and intermediate phases of the computed evolutionary tracks. These stellar models will be organized, documented, and made available to anyone interested. This is a minor part of the project. The major part of the research will investigate the relevance of the computations and theoretical assumptions with respect to the realities of astronomical observations of stars and of star clusters. The computed results will be arranged in such a way that affords direct comparison with the observations for a variety of assumptions about the evolutionary parameters. The theoretical grid of models will be used to study the behavior of a star undergoing mass loss as the star evolves. The evolution of the components of a binary system undergoing mass transfer also will be studied.

SUPPORTED BY U.S. Natl. Science Foundation

10.0012, PLASMA DIAGNOSTICS OF GIANT NONTHERMAL EMISSION NEBULAE
S.J. CZYZAK, Ohio State University, School of Math. & Phys. Scis., *Columbus, Ohio* 43210 (AST76-15727)

The tarantula Nebula (30 Doradus) is the brightest of the gaseous nebulae in the nearby galaxy, the Large Magellanic Cloud, seen in the southern sky at a distance of approximately one hundred seventy thousand light years. The nebula is larger than any emission nebulosity optically observable within our own Milky Way Galaxy. Several astronomers have suggested that 30 Doradus is analagous to the emission cores of galaxies. Both a strong radio source and the core of our galaxy, believed to be radiating in a manner similar to 30 Doradus, are hidden from view by dust clouds. A detailed investigation will be undertaken of the structure of 30 Doradus with emphasis on the dimensions, densities and temperatures of the individual knots and filaments. An assessment will be made of the total mass and the origin of the continuous radiation in the optical wavelength range. Spectrographic observations obtained by M.G. Smith of the Cerro Tololo Interamerican Observatory in Chile will be used. Optical evidence for the distribution of non-thermal emission will be compared with the radio frequency data to see if the sources are the coincident. Additional direct photographs and spectra will be obtained at Cerro Tololo. Observational material will also be obtained at the Hale and Lowell Observatories of the only known optical counterpart of 30 Doradus, NGC 604 in the Triangulum spiral galaxy, two million light years away and thus much fainter. Its characteristics will be related to those of 30 Doradus as a first step in the comparison with ionized hydrogen (HII) regions in other galaxies.

SUPPORTED BY U.S. Natl. Science Foundation

10.0013, THE EFFECT OF PHOSPHORUS ON THE DEVELOPMENT OF THE STRUCTURE OF IRON METEORITES
J.I. GOLDSTEIN, Lehigh University, School of Engin. & Phys. Sci., *Bethlehem, Pennsylvania* 18015 (DES74-22518)

This is a continuation of research supported under NSF grant GA- 15349 and Amendments 01 through 03.

This project involves metallurgical studies of iron meteorites. A combination of chemical analyses and theoretical diffusion models will be used to study: (1) temperatures of formation and cooling rates of iron meteorites; (2) influence of minor components (carbon, phosphorus, cobalt) on the chemical behavior of meteorites during formation and cooling. The results will provide important basic information about the origin of meteorites and planets during formation of the solar system.

SUPPORTED BY U.S. Natl. Science Foundation

10.0014, COSMIC-RAY DATA, AND THE PROPERTIES OF PRODUCTION CROSS SECTIONS FROM 10 TO THE 3RD POWER TO 10 TO THE 7TH POWER GEV

T.K. GAISSER, Franklin Inst. of State of Pa., *Swarthmore, Pennsylvania* 19081 (PHY72-05155 A03)

A program of research will be carried out to extract information about hadronic interactions at ultra-high energies (above 1 TeV) from a study of extensive air-shower and other cosmic-ray data. In addition, related work in particle phenomenology will be done. Astrophysical implications of these studies will be explored.

This work is a continuation of that currently supported by Foundation grant number PHY72-05155 A02.

SUPPORTED BY U.S. Natl. Science Foundation

10.0015, HIGH-RESOLUTION STELLAR SPECTROSCOPY OF LATE-TYPE STARS

D.L. LAMBERT, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (AST75-21803 A01)

The research program is focusing on the evolved late-type stars known as red giant stars. The chemical composition of their atmospheres is being defined. These compositions will be related to theories of the nuclear processing within the stars, and the subsequent mixing of the elements to the stellar surface. Observations to be conducted will serve as tests of theories of stellar evolution and nucleosynthesis.

This is a continuation of work previously supported by NSF grant AST 75-21803.

SUPPORTED BY U.S. Natl. Science Foundation

VOLUME 15 NUMBER 1 / JANUARY 8, 1977

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

No abstracts in this category.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*.

N77-10001* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WINGTIP VORTEX DISSIPATOR FOR AIRCRAFT Patent

James C. Patterson, Jr., inventor (to NASA) Issued 5 Oct. 1976 6 p Filed 28 May 1974 Supersedes N74-26456 (12 - 16, p 1855)

(NASA-Case-LAR-11645-1; US-Patent-3,984,070; US-Patent-Appl-SN-473973; US-Patent-Class-244-130; US-Patent-Class-244-113) Avail: US Patent Office CSCL 01A

A means for attenuating the vortex created at aircraft wingtips which consists of a retractable planar surface transverse to the airstream and attached downstream of the wingtip which creates a positive pressure gradient just downstream from the wing is presented. The positive pressure forces a break up of the rotational air flow of the vortex. Official Gazette of the U.S. Patent Office

N77-10002*# Dynatech R/D Co., Cambridge, Mass.

ANALYSIS AND TESTING OF TWO-DIMENSIONAL VENTED COANDA EJECTORS WITH ASYMMETRIC VARIABLE AREA MIXING SECTIONS Final Report

Lewis A. Maroti, Philip G. Hill, Robert L. Armstrong, and David M. Haines Oct. 1976 155 p refs

(Contract NAS2-8604)

(NASA-CR-2721) Avail: NTIS HC A08/MF A01 CSCL 01A

The analysis of asymmetric, curved (Coanda) ejector flow has been completed using a finite difference technique and a quasi-orthogonal streamline coordinate system. The boundary layer type jet mixing analysis accounts for the effect of streamline curvature in pressure gradients normal to the streamlines and on eddy viscosities. The analysis assured perfect gases, free of pressure discontinuities and flow separation and treated three compound flows of supersonic and subsonic streams. Flow parameters and ejector performance were measured in a vented Coanda flow geometry for the verification of the computer analysis. A primary converging nozzle with a discharge geometry of 0.003175 m x 0.2032 m was supplied with 0.283 cu m/sec of air at about 241.3 KPa absolute stagnation pressure and 82 C stagnation temperature. One mixing section geometry was used with a 0.127 m constant radius Coanda surface. Eight tests were run at spacing between the Coanda surface and primary nozzle 0.01915 m and 0.318 m and at three angles of Coanda turning: 22.5 deg, 45.0 deg, and 75.0 deg. The wall static pressures, the loci of maximum stagnation pressures, and the stagnation pressure profiles agree well between analytical and experimental results. Author

N77-10003*# Washington Univ., St. Louis, Mo. Dept. of Mechanical Engineering.

ROTOR DYNAMIC STATE AND PARAMETER IDENTIFICATION, FROM SIMULATED FORWARD FLIGHT TRANSIENTS, PART 1

K. H. Hohenemser, D. Banerjee, and S. K. Yin Jun. 1976 61 p refs

(Contract NAS2-7613)

(NASA-CR-137963; Rept-3) Avail: NTIS HC A04/MF A01 CSCL 01A

State and parameter identifications from simulated forward flight blade flapping measurements are presented. The transients were excited by progressing cyclic pitch stirring or by hub stirring with constant stirring acceleration. Rotor dynamic inflow models of varying degree of sophistication were used from a one parameter inflow model (equivalent Lock number) to an eight parameter inflow model. The maximum likelihood method with assumed fixed measurement error covariance matrix was applied. The rotor system equations for both fixed hub and tilting hub are given. The identified models were verified by comparing true responses with predicted responses. An optimum utilization of the simulated measurement data can be defined. From the numerical results it can be anticipated that brief periods of either accelerated cyclic pitch stirring or of hub stirring are sufficient to extract with adequate accuracy up to 8 rotor dynamic inflow parameters plus the blade Lock number from the transients. Author

N77-10004*# Washington Univ., St. Louis, Mo. Dept. of Mechanical Engineering.

ROTOR DYNAMIC STATE AND PARAMETER IDENTIFICATION FROM SIMULATED FORWARD FLIGHT TRANSIENTS, PART 2

K. H. Hohenemser and S. T. Crews Jun. 1976 44 p refs

(Contract NAS2-7613)

(NASA-CR-137964; Rept-3) Avail: NTIS HC A03/MF A01 CSCL 01A

State and parameter identifications based on a form of the maximum likelihood method are applied to the problem of extracting linear perturbation models, including rotor dynamic inflow effects, from transient blade flapping measurements. The estimation method is first studied in computer simulations and then applied to cyclic pitch stirring transients generated with a four-bladed rotor model operating in hovering trim conditions. The analytical perturbation models extracted from the transient test results are compared with transient and frequency response tests not used in the state and parameter identification. The identified analytical perturbation model is also compared with a simple theory. The method that is applicable both to small scale and full scale dynamic rotor testing is being extended to perturbations from forward flight trim conditions. Author

N77-10005*# Washington Univ., St. Louis, Mo. Dept. of Mechanical Engineering.
METHODS STUDIES ON SYSTEM IDENTIFICATION FROM TRANSIENT ROTOR TESTS Annual Report, Part 1
K. H. Hohenemser, D. Banerjee, and S. K. Yin Jun. 1975 125 p refs
(Contract NAS2-7613)
(NASA-CR-137965; AR-2-Pt-1) Avail: NTIS HC A06/MF A01 CSCL 01A

Some of the more important methods are discussed that have been used or proposed for aircraft parameter identification. The methods are classified into two groups: Equation error or regression estimates and Bayesian estimates and their derivatives that are based on probabilistic concepts. In both of these two groups the cost function can be optimized either globally over the entire time span of the transient, or sequentially, leading to the formulation of optimum filters. Identifiability problems and the validation of the estimates are briefly outlined, and applications to lifting rotors are discussed. Author

N77-10006*# Washington Univ., St. Louis, Mo. Dept. of Mechanical Engineering.
ADDITIONAL EXPERIMENTS WITH A FOUR-BLADED CYCLIC PITCH STIRRING MODEL ROTOR, PART 2 OF SECOND YEARLY REPORT
K. H. Hohenemser and S. T. Crews Jun. 1975 70 p
(Contract NAS2-7613)
(NASA-CR-137966) Avail: NTIS HC A04/MF A01 CSCL 01A

The four bladed pitch stirring rotor model was used in a rotor dynamic wake survey at zero advance ratio, covering 2 deg, 5 deg and 8 deg collective pitch settings. Dynamic wake data were taken in planes .12 and .20 radii below the rotor disk and are to be compared with analytical wake data with parameters to be identified from pitch stirring transients. The model was modified to perform such transients. The instrumentation developed for this purpose is described together with the method of data acquisition and with the test procedures. The hardware and software for several data handling systems are discussed. These systems extract from pitch stirring transients the parameters of analytical dynamic rotor wake models. Author

N77-10007*# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
SENSITIVITY OF HINGELESS ROTOR BLADE FLAP-LAG STABILITY IN HOVER TO ANALYTICAL MODELLING ASSUMPTIONS
H. C. Curtiss, Jr. Jan. 1975 99 p refs Sponsored in part by Army
(Contract NAS2-7615)
(NASA-CR-137967; AMS-1236) Avail: NTIS HC A05/MF A01 CSCL 01A

Prediction of flap-lag stability using a single bending mode for each degree-of-freedom is examined in the case in which the bending modes are assumed to be the same in the flap and lag directions and are independent of pitch angle and stiffness distribution. It is shown that this model gives results analogous to those obtained by Ormiston employing a rigid blade model with the blade and hub stiffness represented by springs in the limiting cases of the elastic coupling parameter R = 0 and 1. For intermediate values of R the results are shown to be quite different. The mode shape assumptions are shown to result in what is referred to as the parallel spring model in contrast to Ormiston's model which is referred to as a series spring model. The similarities and differences between these two models are developed in some details. The differences between these two models are examined for various typical rotor blade characteristics. Other aspects of the sensitivity of this problem are also considered. Author

N77-10008*# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
AN EXPERIMENTAL STUDY OF THE NONLINEAR STIFFNESS OF A ROTOR BLADE UNDERGOING FLAP, LAG AND TWIST DEFORMATIONS Final Technical Report
E. H. Dowell and J. J. Traybar Jan. 1975 58 p refs Sponsored in part by Army
(Contract NAS2-7615)
(NASA-CR-137968; AMS-1194) Avail: NTIS HC A04/MF A01 CSCL 01A

The large deformation of a cantilevered beam under a gravity tip load was studied. The beam root is rotated so that the tip load is oriented at various angles with respect to the beam principal axes. Static twist and bending deflections of the tip and bending natural frequencies were measured as a function of tip load magnitude and orientation. The experimental data are compared with the results of a recently developed nonlinear structural theory and agreement is good for deflections that are small compared to the beam span with systematic deviations for larger deflections. These results support the validity and utility of the nonlinear structural theory for rotor blade applications. Author

N77-10009*# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
AN EXPERIMENTAL STUDY OF THE NONLINEAR STIFFNESS OF A ROTOR BLADE UNDERGOING FLAP, LAG AND TWIST DEFORMATIONS
E. H. Dowell and J. J. Traybar Dec. 1975 79 p refs Sponsored in part by Army
(Contract NAS2-7615)
(NASA-CR-137969; AMS-1257) Avail: NTIS HC A05/MF A01 CSCL 01A

This is an addendum to an experimental study of the large deformation of a cantilevered beam under a gravity tip load. It adds higher quality and new data on the static twist and bending deflections of the beam. The experimental data are compared with a recently developed nonlinear structural theory. Agreement is good for deflections that are small compared to the beam span and has systematic deviations for larger deflections. Author

N77-10010*# Chrysler Corp., New Orleans, La. Space Div.
HIGH SUPERSONIC AERODYNAMIC CHARACTERISTICS OF FIVE IRREGULAR PLANFORM WINGS WITH SYSTEMATICALLY VARYING WING FILLET GEOMETRY TESTED IN THE NASA/LARC 4-FOOT UPWT (LEG 2) (LA45A/B)
Oct. 1976 478 p ref
(Contract NAS9-13247)
(NASA-CR-147628; DMS-DR-2297) Avail: NTIS HC A21/MF A01 CSCL 01A

An experimental and analytical aerodynamic program to develop predesign guides for irregular planform wings is reported. The benefits are linearization of subsonic lift curve slope to high angles of attack and avoidance of subsonic pitch instabilities at high lift by proper tailoring of the planform fillet wing combination while providing the desired hypersonic trim angle and stability. The two prime areas of concern are to optimize shuttle orbiter landing and entry characteristics. Basic longitudinal aerodynamic characteristics at high supersonic speeds are developed. Author

N77-10011*# Transemantics, Inc., Washington, D.C.
SOLUTION OF THE PROBLEM OF FLOW AROUND A THIN BLUNT BODY OF REVOLUTION SUBJECTED TO A HYPERSONIC GAS STREAM
N. M. Monakhov NASA Nov. 1976 10 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats Tekh. (USSR), no. 2, Feb. 1976 p 106-110
(Contract NASw-2792)
(NASA-TT-F-17281) Avail: NTIS HC A02/MF A01 CSCL 01A

The flow around thin bodies of revolution, whose shock waves are similar to parabolic shock waves in the asymptotic theory of blunt bodies are described. Equations of perturbed flow and the shape of spherically blunt bodies and flow parameters on their surfaces are discussed. A comparatively small deformation of the reference waves causes a significant change in the shape of the body as well as the pressure and density on its surface. Author

N77-10012*# Transemantics, Inc., Washington, D.C.
MECHANISM OF STABILIZATION OF THE 'SEPARATION POINT' OF A VORTEX DURING FLOW OF A STREAM AT LOW SUBSONIC VELOCITY OVER A DELTA WING
E. A. Truneva NASA Nov. 1976 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Aviats. Tekh. (USSR), no. 2, Feb. 1976 p 106-110

(Contract NASw-2792)
(NASA-TT-F-17283) Avail: NTIS HC A02/MF A01 CSCL 01A

The mechanism of vortex separation and displacement of the separation point beginning with the development of the separation phenomenon is presented. The results of this research may be valuable for determination of stresses on the wind and investigation of non-stationary aerodynamic characteristics of aircraft with delta wings, in the low velocity region, corresponding to takeoff and landing. Author

N77-10013*# Lockheed-Georgia Co., Marietta.
NEW DEVELOPMENTS IN BLOWN FLAP NOISE TECHNOLOGY
John S. Gibson 1976 12 p refs Presented at the 10th Congr. of ICAS, Ottawa, 3-8 Oct. 1976
(Contract NAS1-13870)
(NASA-CR-145086) Avail: NTIS HC A02/MF A01 CSCL 01A

The noise technology relating to blown-flap systems is reviewed. There are three general sources of noise: turbomachinery, airframe, and the interaction noise of the jet blowing on the flaps. The latter noise-source area is the most critical and the main subject dicussed. Characteristics of lower surface blown and upper surface blown systems are described, including noise spectra, directivity, jet velocity characteristics, aircraft geometric variation effects, and aircraft forward speed effects. Noise reduction concepts are described, including slowing down the jet flow field by devices and engine cycle modifications, structural geometry and shielding modifications, local flow field modifications of the passive and active type, and the absorption of noise. It is concluded that, while there has been considerable progress in the past several years, low noise characteristics in blown flap aircraft must be largely built in by better application of low noise principles during the design. Author

N77-10014*# Lockheed-Georgia Co., Marietta.
NUMERICAL STUDIES OF THREE-DIMENSIONAL BREAKDOWN IN TRAILING VORTEX WAKES
P. F. Evans and J. E. Hackett Jun. 1976 100 p refs
(Contract NAS2-8651)
(NASA-CR-137888) Avail: NTIS HC A05/MF A01 CSCL 20D

Finite element, three dimensional relaxation methods are used to calculate the development of vortex wakes behind aircraft for a considerable downstream distance. The inclusion of a self-induction term in the solution, dependent upon local curvature and vortex core radius, permits calculation of finite lifetimes for systems for which infinite life would be predicted two dimensionally. The associated computer program is described together with single-pair, twin-pair, and multiple-pair studies carried out using it. It is found, in single-pair studies, that there is a lower limit to the wavelengths at which the Crow-type of instability can occur. Below this limit, self-induction effects cause the plane of the disturbance waves to rotate counter to the vortex direction. Self induction in two dimensionally generated twin spiral waves causes an increase in axial length which becomes more marked with decreasing initial wavelength. The time taken for vortex convergence toward the center plane is correspondingly increased. The limited parametric twin-pair study performed suggests that time-to-converge increases with increasing flap span. Limited studies of Boeing 747 configurations show correct qualitative response to removal of the outer flap and to gear deployment, as compared with wind tunnel and flight test experience. Author

N77-10015# Aerospace Corp., El Segundo, Calif.
ATMOSAT: A NEW MEASUREMENT PLATFORM FOR AIR QUALITY MONITORING
T. F. Heinsheimer and P. C. Neushul Oct. 1976 54 p refs Presented at the Air Force Geophysics Laboratory Scientific Balloon Conf., Oct. 1976
(ATR-76(8192)-5) Avail: NTIS HC A04/MF A01

The first manned superpressure balloon was developed to provide a means for accurately following a parcel of air, making physical and chemical measurements en route. The use of new high strength fabrics allows the construction of a balloon that contains its lifting gas (helium) under pressure, thereby providing long term flight stability unachieved by any other method. Three flights, each in excess of 30 hours duration, were achieved, demonstrating the ability of such vehicles to remain stably in a parcel of air without perturbing air chemistry in any way. Such a platform allows the precise determination of air trajectories over many hundreds of miles. The use of trained observers on board facilitates the collection of atmospheric data: ozone, NOx, SO2, temperature gradients, turbulence, etc. Author

N77-10016# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Theoretische Aerodynamik.
APPLICATION OF THE PANEL METHOD TO CALCULATION OF THE WIND LOADS ON GRAIN SILOS IN SINGLE AND GROUP CONFIGURATIONS [ANWENDUNG DES PANEL-VERFAHRENS ZUR BERECHNUNG DER WINDBELASTUNG VON GETREIDE-SILOS IN EINZEL- UND GRUPPENANORDNUNG]
S. R. Ahmed Nov. 1975 30 p refs In GERMAN
(DLR-IB-151-75/20) Avail: NTIS HC A03/MF A01

The panel method, which allows calculation of velocity and pressure fields around arbitrarily formed three-dimensional bodies, is extended for determination of the static wind loads on structures such as circular cylindrical grain silos. The extension covers the unavoidable flow separation which is accounted for by a simple simulation of the boundary of the separation area. Theoretical results are compared with wind tunnel tests. The effects of variation of the ratio between height and diameter, and the closure of the open container side upon the wind load, were of main importance. Results provide information for the design of silos and similar structures. The effect of wind incidence on the wind load of two adjacent silos was also investigated. ESA

N77-10017# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STUDY OF THE SUBSONIC FLOW AROUND A SHARP LEADING EDGE
Gerard Laruelle and Paul Levart Assoc. Aeron. et Astronautique de France 1976 23 p refs In FRENCH; ENGLISH summary Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-14; ISBN-2-7170-0396-7) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

The subsonic flow around a sharp leading edge, resulting from the air intake drag of supersonic aircraft flying at subsonic speeds, was studied. The calculation method used is presented and the simulation of leading edge separation is detailed. The experimental setup is presented (S5 wind tunnel at Chalais-Meudon, France). The calculated and measured values were compared and found to be satisfactory. An adaptation of the computer program for potential flow by finite differences was attempted. ESA

N77-10018# Aix-Marseilles Univ. (France). Inst. de Mecanique de Fluides.
STUDY OF A TWO DIMENSIONAL SUPERSONIC AIR INLET PROVIDED WITH A BOUNDARY LAYER TRAP [ETUDE D'UNE ENTREE D'AIR BIDIMENSIONNELLE MUNIE D'UN PIEGE A COUCHE LIMITE EN REGIME SUPERSONIQUE]
J. Marcillat and L. Salles Paris Assoc. Aeron. et Astronautique de France 1976 67 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-19; ISBN-2-7170-0397-5) Avail: NTIS HC A04/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

A two-dimensional air inlet model was tested in a supersonic wind tunnel in order to reduce the effects of shock wave and boundary layer trap. The experimental conditions are detailed and the evaluation of the measuring results is discussed. Various types of traps were used and it is concluded that the shock wave/boundary layer interaction can be attenuated if not suppressed by aspiration of the boundary layer at the lower side of the shock wave. ESA

N77-10019# Aix-Marseilles Univ. (France). Inst. de Mecanique des Fluides.

EXPERIMENTAL STUDY OF THE AERODYNAMICS OF A HELICOPTER ROTOR IN TRANSLATIONAL FLIGHT. TWO DIMENSIONAL SIMULATION OF THE EFFECTS DUE TO CYCLIC VARIATIONS OF THE VELOCITY VECTOR [ETUDE EXPERIMENTALE RELATIVE A L'AERODYNAMIQUE D'UN ROTOR D'HELICOPTERE EN VOL DE TRANSLATION: SIMULATION EN ECOULEMENT PLAN DES EFFETS DUS AUX VARIATIONS CYCLIQUES DU VECTEUR VITESSE]

J. Rebont, C. Maresca, A. Guillerminet, and D. Favier Paris Assoc. Aeron. et Astronautique de France 1976 37 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975

(AAAF-NT-76-20; ISBN-2-7170-0398-3) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

Aerodynamic characteristics of a helicopter wing harmonic oscillations of which the vector is parallel to the main flow were studied in a subsonic wind tunnel. NACA profile 0012 (l = 0.495 m, c = 0.3 m) was used, angle of attack between -20 and 20 deg and Reynolds number between 60,000 and 400,000. It is shown that the instability effects remain small with small angle of attack and with oscillation frequencies below 0.26. ESA

N77-10020# Centre National de la Recherche Scientifique, Orsay (France).

CALCULATION OF TRANSONIC CASCADE FLOW WITH SHOCK. COMPARISON WITH WIND TUNNEL TESTS [CALCUL DES GRILLES D'AUBES TRANSSONIQUES AVEC CHOCK CONFRONTATION AVEC LES ESSAIS EN SOUFFLERIE]

T. S. Luu and G. Worms (SNECMA) Paris Assoc. Aeron. et Astronautique de France 1976 25 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975

(AAAF-NT-76-21; ISBN-2-7170-0399-1) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

The transonic cascade flow was calculated by the finite difference method. The flow equation gives velocity potentials in the orthogonal system of flow lines and equipotentials of the incompressible cascade flow. The transonic field potential was determined by the relaxation method using a finite difference, decentralized upstream for the supersonic nodes and centralized for the subsonic nodes. An explanation is given for the appearance, in the calculations, of compression waves. Comparison of the calculations with the wind tunnel tests was found to be satisfactory. ESA

N77-10021# European Space Agency, Paris (France).

THE HYPERSONIC FLOW ALONG A SLENDER BODY WITH ROUNDED NOSE FOR SMALL REYNOLDS NUMBERS

Dietrich Vennemann Sep. 1976 90 p refs Transl. into ENGLISH of 'Ueber die hypersonische Umstroemung eines laengsgestreckten stumpfen Koerpers im Bereich kleiner Reynoldszahlen', DFVLR, Goettingen, West Ger. Report DLR-FB-75-73, 28 Nov. 1975 Original German report available from DFVLR, Cologne, DM 44.60

(ESA-TT-309; DLR-FB-75-73) Avail: NTIS HC A05/MF A01

Experimental investigations of the low density flow field along a circular cylinder with a hemispherical nose were carried out. The type of flow is in the regime between continuum flow and free molecular flow. The results for the heat transfer coefficients complete former experimental results and allow a comparison to be made with different theories for the transition regime. The experimental results on the temperature field of the vibrational and the rotational temperature, and especially of the density, which were obtained by the electron beam technique, give information on the shock strength, the distance of the shock from the body, the intensity of the shock, and the deviation of these quantities from the corresponding values for continuum flow. Author (ESA)

N77-10022# European Space Agency, Paris (France).

INFLUENCE OF VIBRATIONAL RELAXATION ON HYPERSONIC STAGNATION FLOW OF VISCOUS GASES

B. Schmitt-vonSchubert Feb. 1976 107 p refs Transl. into ENGLISH of "Einfluss der Schwingungsrelaxation auf die Staupunktstroemung zaeher Gase bei Hyperschallgeschwindigkeit", DFVLR, Goettingen, West Ger. Report DLR-FB-75-50, 28 Jul. 1975 Original German report available from DFVLR, Cologne DM 49.40

(ESA-TT-252; DLR-FB-75-50) Avail: NTIS HC A06/MF A01

The qualitative behavior of the hypersonic flow around a blunt body depending on the density of the gas was studied. In particular the merged layer regime was considered. The rarefaction of the gas was assumed to be high enough to cause a merging of the shock wave and the boundary layer, but the use of the continuum theory was assumed justified. In the vicinity of the stagnation streamline the flow field was calculated numerically. A first set of examples was calculated for the case of vibrational equilibrium in the freestream, which was given at atmospheric flight. For a second set of examples, the freestream vibrational temperature was chosen different from the freestream translational and rotational temperature; such situations were given during the simulation of atmospheric flight in a wind tunnel. For the second set of examples the calculated results were compared with experimental results. Author (ESA)

N77-10023# ARO, Inc., Arnold Air Force Station, Tenn.

AN INTEGRAL EQUATION METHOD FOR BOUNDARY INTERFERENCE IN A PERFORATED-WALL WIND TUNNEL AT TRANSONIC SPEEDS Final Report, Jan. 1974 - Oct. 1975

E. M. Kraft AEDC Apr. 1976 84 p refs

(AD-A023493; ARO-PWT-TR-75-162; AEDC-TR-76-43) Avail: NTIS HC A05/MF A01 CSCL 20/4

The wind tunnel boundary interference at transonic speeds on a thin airfoil in a two-dimensional perforated-wall wind tunnel was determined. The interference was found by applying an integral equation method to the nonlinear transonic small disturbance equation including embedded supersonic regions with shock waves. The kernels of the ensuing integral equation were replaced by series approximations, and the integrals were evaluated in closed form. The iterative technique used to calculate the interference from the integral equation method is shown to converge rapidly, and the computing time for the integral equation method is typically an order of magnitude less than present numerical methods. As a special case, the integral equation method for a thin airfoil in free air was also examined. It was found that the introduction of a novel influence function yields, for the first time, a self-contained integral equation for a lifting airfoil. In addition, a systematic study of the classical assumption used to simplify the integral equation shows that the integral method can provide solutions in good agreement with results from the numerical methods. GRA

N77-10024# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN INVESTIGATION OF THE EFFECT ON AERODYNAMIC FORCES CAUSED BY THE ADDITION OF END PLATES TO HELICOPTER ROTOR BLADES M.S. Thesis

Roger J. Korenberg Jun. 1975 76 p refs

(AD-A023541; GAM/AE/74D-11) Avail: NTIS HC A05/MF A01 CSCL 01/1

The purpose of this investigation was to determine the effects on lift, drag, and thrust produced by a helicopter rotor after installing end plates on the blades. Fixed wing end plate theory was applied in a modified form to rotor blade calculations to investigate correlation. The results indicate that end plate factors are not satisfactory analytic tools for rotor blade calculations. End plates do increase the effective rotor radius and increase the lift at a given angle of attack and RPM; however, there are heavy penalties in power required. GRA

N77-10025# Naval Air Development Center, Warminster, Pa. Dept. of Air Vehicle Technology.

DEVELOPMENT AND TEST OF FLOCELERATOR FOR HEAVY WEIGHT SONOBUOYS (ERAPS) Final Report

Robert E. Ainslite 11 Dec. 1975 88 p refs

(AD-A024163; NADC-75239-30) Avail: NTIS HC A05/MF A01 CSCL 17/1

Ram-air filled flotation bags combined with cross type parachutes were developed and tested for use with heavy weight

sonobuoys. These devices are called by the acronym - FLOCELERATOR. Some flocelerators used flexible tubular valves and others rotating plate valves with soluble aspirin tablets to retain the air after inflation and impact with the sea. Air drop tests of the flocelerators proved feasibility of flocelerator and demonstrated satisfactory operation of tubular and plate valves. Author (GRA)

N77-10026# Naval Surface Weapons Center, White Oak, Md.
NORMAL IMPINGEMENT OF A SUPERSONIC JET ON A PLANE: A BASIC STUDY OF SHOCK-INTERFERENCE HEATING
Kuei-Yuan Chien 20 Dec. 1975 60 p refs
(AD-A024511; NSWC/WOL/TR-75-195) Avail: NTIS HC A04/MF A01 CSCL 20/4

The problem of a balanced, planar or axisymmetric, supersonic jet impinging normally on a flat surface has been considered based on an inviscid theory. The object of the study was to provide a rational model for calculating shock-interference heating as produced by a type IV shock-interaction pattern. The unwanted singularity at a low supersonic Mach number peculiar to scheme I of the one-strip formulation of the method of integral relations, as observed by South and by Gummer and Hunt, was successfully removed by the application of the scheme III of the one-strip formulation of the method of integral relations. The resulting simultaneous nonlinear algebraic equations were easily solved iteratively by the Newton-Raphson method. Sensitivity of the solution on various approximating functions employed was extensively investigated. Unlike the findings reported by Gummer and Hunt, solutions that satisfy all well-posed boundary conditions can be obtained by the one-strip formulation. Results indicate that, for the planar case, a rational engineering solution for the stagnation-point velocity gradient (and hence the peak heat-transfer rate) has been obtained. For the axisymmetric case, however, solutions appear to be not quite converging. A two-strip formulation based on the method of integral relations is also included. Author (GRA)

N77-10027# McDonnell Aircraft Co., St. Louis, Mo.
PERFORMANCE OF STEADY AND INTERMITTENT BLOWING JET FLAPS AND SPANWISE UPPER SURFACE SLOTS Final Report, Apr. 1973 - Nov. 1975
W. L. Ely and F. C. Berrier Nov. 1975 514 p refs
(Contract F33615-73-C-3056; AF Proj. 1476)
(AD-A024364; AFFDL-TR-75-128) Avail: NTIS HC A22/MF A01 CSCL 20/4

A wind tunnel test was conducted in the NASA Ames 14 foot wind tunnel to determine the performance of steady and pulsed blown jet flaps and constant percent chord spanwise upper surface slots; and to provide wing load and tail power data for a proposed Air Force COMMA (Composite Maneuver Augmentation) RPV flight test program. The tests were performed on a 72.1% scale semi-span model of the proposed vehicle with a wing leading edge sweep of 45 deg over a Mach number range of 0.4 to 1.1. The Reynolds number was approximately 4 million per foot and the angle of attack range was -5 deg to -25 deg. Full and partial span jet flaps; jet flap angles of 30 deg, 60 deg and 80 deg; 40% and 70% constant chord slots; and horizontal tail deflections of +2 deg, 0 deg, -2 deg, -4 deg and -6 deg were tested over a blowing momentum coefficient range of 0 to 0.018. Balance forces, wing upper and lower surface static pressures, wing root bending moment, wing tip accelerometer, and flow visualization data were obtained. The results in general indicated that slot blowing was ineffective, jet flaps provided lift augmentation at all angles of attack tested and drag reduction at high lift conditions, and pulsed blowing provided minor benefits over steady blowing. Trimmed jet flap data indicates a Mach dependence on jet flap performance and that jet flaps provide a performance advantage only at high lifts. Author (GRA)

N77-10028# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
THE DEVELOPMENT OF A COMPUTER AIDED AIRFOIL DESIGN PROCEDURE INCLUDING PRELIMINARY WIND TUNNEL EXPERIMENTS ON A LOW REYNOLDS NUMBER HIGH LIFT SECTION, VOLUME 1 Final Report, 1 Dec. 1970 - 30 Nov. 1975
Jimmy Charles Narramore, Ralph Dean Orlander, and Ronald Oran Stearman Jan. 1976 153 p refs
(Grant AF-AFOSR-1998-71; AF Proj. 9782)
(AD-A024361; AFOSR-76-0536TR) Avail: NTIS HC A08/MF A01 CSCL 20/4

An investigation on the state of the art of subsonic airfoil section design, including a review of the historical development of airfoil design methodology, was carried out. A computer aided airfoil design procedure employing current technology was developed and utilized to design a low-Reynolds number, high-lift airfoil section. Preliminary wind tunnel studies were carried out on this high-lift section and the influence of flow disturbances on its performances evaluated. This study represents the first phase in determining how changes in airfoil design parameters influence the dynamical properties of the airfoil. Author (GRA)

N77-10029# Advanced Technology Center, Inc., Dallas, Tex.
TEST VERIFICATION OF A TRANSONIC AIRFOIL DESIGN EMPLOYING ACTIVE DIFFUSION CONTROL Final Report, 13 Jun. 1974 - 14 Jun. 1975
C. H. Haight and J. G. Spangler 1975 90 p refs
(Contract N62269-74-C-0517)
(AD-A024297; ATC-B-94300/5CR-34) Avail: NTIS HC A05/MF A01 CSCL 20/4

Experimental results are presented that show active diffusion control, with its integrated contouring/blowing characteristics, to be a viable concept for relaxing transonic airfoil design constraints. The antiseparation tailored contour (ATC) is the basic device for active diffusion control. A modified 12% thick C-141 section with a trailing edge upper surface ATC, designated as the TEATC12 airfoil, was selected as the proof-of-concept configuration. It incorporates the main features of active diffusion control while providing a reliable baseline for comparison. The transonic BLC/diffusion process was modeled in an axisymmetric diffuser facility. Blowing predictions for the ATC geometry were substantiated, and interactions between the jet and the mainstream were examined. Experimental verification was completed by testing a TEATC12 airfoil model in the Vought Systems Division High Speed Wind Tunnel. A C-141 model was also tested to provide a direct reference for the TEATC12 results. Author

N77-10030# Aeronautical Research Associates of Princeton, Inc., N.J.
THE CALCULATION OF TURBULENT COMPRESSIBLE BOUNDARY LAYERS WITH INJECTION OF A FOREIGN GAS Final Report, 1 Oct. 1970 - 30 Nov. 1975
Robert A. Beddini, Roger D. Sullivan, and E. Stokes Fishburne Jan. 1976 28 p refs
(Contract F44620-71-C-0004; AF Proj. 9781)
(AD-A024292; ARAP-270; AFOSR-76-0508TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

A second-order closure technique for the compressible turbulent boundary layer equations has been developed. The technique is employed in the calculation of boundary layers with surface injection of similar and foreign gases. Theoretical results for M approximately 3 and several air injection rates provide favorable comparison with experimental data. Theoretical mean velocity and mass fraction profiles for a propane injected oxygen boundary layer are also presented. The additional ability of the technique to accommodate finite rate chemical reactions in a multi-species system was investigated. Preliminary results are provided for the rapidly developing region of flow downstream of an ignition and turbulence source. Application of the closure technique to the calculation of a variety of reacting shear flows is currently being performed at ARAP. GRA

N77-10347*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
LIFTING SURFACE THEORY FOR RECTANGULAR WINGS
Fred R. DeJarnette *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1301-1309 refs (For primary document see N77-10345 01-31)
(Grant DAAG29-76-G-0045)
Avail: NTIS HC A22/MF A01

N77-10348*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IMPROVED COMPUTATIONAL TREATMENT OF TRANSONIC FLOW ABOUT SWEPT WINGS
W. F. Ballhaus (AMRDL), F. R. Bailey, and J. Frick (Informatics,

Inc., Palo Alto, Calif.) *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1311-1320 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 01A

N77-10349*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
APPLICATION OF THE NONLINEAR VORTEX-LATTICE CONCEPT TO AIRCRAFT-INTERFERENCE PROBLEMS
Osama A. Kandil, Dean T. Mook, and Ali H. Nayfeh *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1321-1330 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

N77-10350*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN APPLICATION OF THE SUCTION ANALOG FOR THE ANALYSIS OF ASYMMETRIC FLOW SITUATIONS
James M. Luckring *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1331-1347 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 01A

N77-10351*# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
TRANSONIC FLOW THEORY OF AIRFOILS AND WINGS
P. R. Garabedian *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1349-1358 refs (For primary document see N77-10345 01-31)
(Grants NGR-33-016-167; NGR-33-016-201; Contract AT(11-1)-3077)
Avail: NTIS HC A22/MF A01

N77-10352*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE MULTIGRID METHOD: FAST RELAXATION
Jerry C. South, Jr. and Achi Brandt (Weizmann Inst. of Sci., Rehovot, Israel) *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1359-1369 refs (For primary document see N77-10345 01-31)
(Grant NGR-47-102-001)
Avail: NTIS HC A22/MF A01 CSCL 01A

N77-10353*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF FINITE ELEMENT APPROACH TO TRANSONIC FLOW PROBLEMS
Mohamed M. Hafez, Earll M. Murman, and London C. Wellford *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1371-1393 refs (For primary document see N77-10345 01-31)
(Contract NAS1-14246)
Avail: NTIS HC A22/MF A01 CSCL 01A

N77-10354*# Texas A&M Univ., College Station.
INVERSE TRANSONIC AIRFOIL DESIGN INCLUDING VISCOUS INTERACTION
Leland A. Carlson *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1387-1395 refs (For primary document see N77-10345 01-31)
(Grant NsG-1174)
Avail: NTIS HC A22/MF A01

N77-10355*# Mississippi State Univ., Mississippi State.
NUMERICAL SOLUTIONS FOR LAMINAR AND TURBULENT VISCOUS FLOW OVER SINGLE AND MULTI-ELEMENT AIRFOILS USING BODY-FITTED COORDINATE SYSTEMS
Joe F. Thompson, Z. U. A. Warsi, and B. B. Amlicke *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1397-1407 refs (For primary document see N77-10345 01-31)
(Grants NGR-25-001-005; AF-AFOSR-2922-76)
Avail: NTIS HC A22/MF A01

N77-10356*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
THREE-DIMENSIONAL BOUNDARY LAYERS APPROACHING SEPARATION
James C. Williams, III *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1409-1421 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

N77-10357*# Michigan Univ., Ann Arbor.
SHOCK WAVE-TURBULENT BOUNDARY LAYER INTERACTIONS IN TRANSONIC FLOW
T. C. Adamson and A. F. Messiter *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1425-1435 refs (For primary document see N77-10345 01-31)
(Grant NGR-23-005-523)
Avail: NTIS HC A22/MF A01

N77-10358*# Ohio State Univ., Columbus.
SEPARATED LAMINAR BOUNDARY LAYERS
Odus R. Burggraf *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1437-1450 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

N77-10365*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCED TRANSONIC AERODYNAMIC TECHNOLOGY
Richard T. Whitcomb *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1521-1537 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 01A

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

N77-10031# Stanford Research Inst., Menlo Park, Calif.
FORECASTS AND ANALYSIS OF INTERNATIONAL AIR TRAFFIC FOR THE AEROSAT PROGRAM: THE ATLANTIC OCEAN BASIN
James Gorham, Randall Pozdena, and Jerome Johnson Apr. 1976 302 p refs
(Contract DOT-FA75WA-3574-1)
(AD-A027880/4; MSU-4004; FAA-RD-76-15) Avail: NTIS HC A14/MF A01 CSCL 01/2

The level of international air traffic in the Atlantic Ocean region is analyzed for the base year of 1975 and forecast for the years of 1980, 1985, 1990, and 1995. For forecasting interregional air traffic, a model is developed that uses forecasts of regional economic and population data and data on fuel prices and other aircraft operating costs. A model is described that transforms these traffic forecasts into estimates of instantaneous airborne counts and other activity statistics for defined areas of the Atlantic Ocean basin. The evidence indicates that rather significant and broad aircraft peak counts can be anticipated over the analysis region. These aircraft are potential users of satellite-aided aviation support systems. Author

N77-10032*# Lockheed-California Co., Burbank.
LH2 AIRPORT REQUIREMENTS STUDY Final Report, Sep. 1975 - Feb. 1976
G. D. Brewer, ed. Oct. 1976 202 p refs
(Contract NAS1-14137)
(NASA-CR-2700; LR-27581) Avail: NTIS HC A10/MF A01 CSCL 21D

A preliminary assessment of the facilities and equipment which will be required at a representative airport is provided so liquid hydrogen LH2 can be used as fuel in long range transport aircraft in 1995-2000. A complete facility was conceptually designed, sized to meet the projected air traffic requirement. The facility includes the liquefaction plant, LH2, storage capability, and LH2 fuel handling system. The requirements for ground support and maintenance for the LH2 fueled aircraft were analyzed. An estimate was made of capital and operating costs which might be expected for the facility. Recommendations were made for design modifications to the reference aircraft, reflecting results of the analysis of airport fuel handling requirements, and for a program of additional technology development for air terminal related items. Author

N77-10033*# Boeing Commercial Airplane Co., Seattle, Wash. Dept. of Preliminary Design.
AN EXPLORATORY STUDY TO DETERMINE THE INTEGRATED TECHNOLOGICAL AIR TRANSPORTATION SYSTEM GROUND REQUIREMENTS OF LIQUID-HYDROGEN-FUELED SUBSONIC, LONG-HAUL CIVIL AIR TRANSPORTS Final Report
Washington NASA Sep. 1976 176 p refs Prepared in cooperation with United Airlines and Air Products and Chemicals, Inc.
(Contract NAS1-14159)
(NASA-CR-2699; D6-75775) Avail: NTIS HC A09/MF A01 CSCL 01C

A baseline air terminal concept was developed which permitted airlines and the airport to operate JP- or LH2-fueled aircraft at common terminal gates. The concept included installation of a hydrogen liquefaction and storage facility on airport property, as well as the fuel distribution system. The capital investment and hydrogen-related operating costs to the airlines were estimated. Author

N77-10034# Simat, Helliesen and Eichner, Inc., Washington, D.C.
AN ANALYSIS OF THE INTRASTATE AIR CARRIER REGULATORY FORUM. VOLUME 1: SUMMARY REPORT
Jan. 1976 49 p
(Contract DOT-OST-60078)
(AD-A023761) Avail: NTIS HC A03/MF A01 CSCL 05/3

Although the regulatory environments in Texas and California differ substantially, each has resulted in the establishment of carriers which are specialized in their desire and ability to serve medium- and high-density short-haul markets. Further, each has allowed these carriers to pursue a marketing and operational philosophy which has enabled them to achieve improved productivity and, as a result, charge lower fares. CAB regulation, on the other hand, has produced both tight control of entry and tight rate regulation, and has required equal fares for markets of the same distance. Consequently, there has been no development of specialized interstate carriers serving short-haul routes of density comparable to those served by the intrastate carriers. Application of a 'two-tier' pricing system, along with improved frequency, would be expected to double the traffic volume in these markets, generating more than 18 million additional air passengers each year. GRA

N77-10035# Simat, Helliesen and Eichner, Inc., Washington, D.C.
AN ANALYSIS OF THE INTRASTATE AIR CARRIER REGULATORY FORUM. VOLUME 2: TECHNICAL REPORT Final Report
L. J. Eichner, N. S. Simat, K. T. Carlson, and R. A. Sunshine Jan. 1976 420 p refs
(Contract DOT-OS-60078)
(AD-A023762) Avail: NTIS HC A18/MF A01 CSCL 05/3

Intrastate air carriers in California and Texas have succeeded in earning profits and providing a high level of service while keeping fares well below those charged by interstate air carriers. The three carriers analyzed in this report are not subject to regulation by the Civil Aeronautics Board (CAB), which controls both rates and routes of the trunk and local interstate air carriers. The different regulatory environments impact on the performance of the aviation system. Sixty interstate markets are identified with potential for profitable operation at high levels of service at lower air fares, and regulatory requirements to allow such service to develop can be identified. Author (GRA)

N77-10036# California Univ., Los Angeles. Graduate School of Management.
THE HELICOPTER AIR SERVICE PASSENGER PROGRAM: A RETROSPECT Research Report, 1974 - 1975
Tim Yeomans and Frank G. Mittelbach Sep. 1975 60 p refs
(PB-254830/3; CAL-URT-7(7)T-35; UMTA-CA-11-0009-75-4; Occasional-Paper-10) Avail: NTIS HC A04/MF A01 CSCL 01B

The initial expectations for helicopter development and the reasons behind the helicopter's ability or inability to fulfill its predicted role in moving large numbers of people in cities and between cities and outlying areas are discussed. Attention is directed to basic helicopter characteristics and capabilities the rationale behind the helicopter experiment, the effects of a federal subsidy granted to the industry, and an analysis of four certified helicopter carrier operations. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications*.

N77-10037# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DEVELOPMENT OF A DISCRETE ADDRESS BEACON SYSTEM Quarterly Technical Summary, 1 Jan. - 31 Mar. 1976
1 Apr. 1976 74 p
(Contract DOT-FA72WAI-261; Proj. 034-241-012)
(AD-A027265/8; FAA-RD-76-82; QTS-17) Avail: NTIS HC A04/MF A01 CSCL 17/7

The results of analytical studies, laboratory and flight experiments, and softwave developments supporting the concept feasibility and performance definition phase of the discrete address beacon system are covered. Author

N77-10038# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EXTENDED STORAGE FEATURE MODIFICATIONS TO THE 9020A SYSTEM Final Report, May - Nov. 1975
Donald A. Fisher, Lane G. Hinkley, and Charles R. Shaw Jun. 1976 53 p refs
(AD-A027281/5; FAA-NA-76-15; FAA-RD-76-89) Avail: NTIS HC A04/MF A01 CSCL 17/7

In order to meet the future demands of the air traffic control upgraded third generation system, hardware/software architectural design changes were developed to provide additional core storage and processing capability. These changes, known as the extended storage feature, were implemented in the 9020A System. The hardware/software modifications, acceptance tests, and cost considerations involved in implementing this feature are discussed. The extended storage feature can be implemented at the 10 enroute ATC 9020A System sites for a total cost of $1,633,000, including all hardware and software modifications required to equip each site with two 7251-08A storage elements. Implementation of the extended storage feature will increase the storage capacity of a 9020A System by 64K words per storage element converted without requiring additional floor space and can be installed without impacting operational activity. Author

N77-10039# ASE, Inc., Pennsauken, N.J.
DEVELOPMENT AND TEST OF LOW IMPACT RESISTANCE STRUCTURES. INSTALLATION OF APPROACH LIGHTING SYSTEM AT RUNWAY 31, NAFEC, PHASE 2 Final Report
Charles W. Laible and John Lazarin Jun. 1976 23 p
(Contract DOT-FA72WA-3043)
(AD-A028321/8; FAA-RD-76-106) Avail: NTIS HC A02/MF A01 CSCL 17/7

A Breakaway Pole was designed, developed, and tested to satisfy the requirements for a frangible light support structure for use with airport lighting. A Category II Approach Lighting System was designed and installed at R/W 31, National Aviation Facility Engineering Center (NAFEC), Atlantic City, N. J. All lights, 6 feet above ground and higher, are supported by the newly developed frangible poles. A sub station was designed and installed to control and regulate power to the ALS and includes 3 50 KVA L-828 Type Regulators. The wiring and control configurations permit the display of either an ALSF-II or a SSALSR approach lighting system. An experimental flasher system supplied by the FAA is incorporated in the installation. A new Mimic Control Panel was designed to control and display the status of taxiway and runway lighting. This control panel permits the controller to

monitor the airport lighting at a glance, thus increasing his efficiency. This panel will also result in energy savings because it makes it easier for the controller to activate only the lights that are necessary. Author

N77-10040# Royal Netherlands Meteorological Inst., De Bilt.
EXPERIMENTS WITH THE RVR-CONVERTER AT DIFFERENT CONDITIONS OF BACKGROUND LUMINANCE [EXPERIMENTEN MET DE RVR-CONVERTER BIJ VERSCHILLENDE ACHTERGRONDHELDERHEDEN]
F. Cannemeijer and J. P. deJongh 1976 29 p refs In DUTCH; ENGLISH summary
(KNMI-WR-76-3) Avail: NTIS HC A03/MF A01

Runway visual range (RVR) values were determined, under varying background luminance conditions, using the RVR converter. The measurements were made to compare the dependency of the RVR on both the transmission of light through the atmosphere and the background luminance under night, day, and twilight conditions. Some theoretical aspects of the RVR concept are dealt with and the components and operation of the RVR converter are described. The measured RVR values are compared with the values specified by the Royal Netherlands Meteorological Institute (KNMI). It is concluded that under daylight and twilight background luminance conditions the measured values are in good agreement (within 50 m) with the KNMI specifications. At night there is a good agreement between 400 and 1000 m; above 1000 m RVR the maximum deviation is 150 m. ESA

N77-10041# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Dynamik der Flugsysteme.
FAST PRECISION ALIGNMENT OF AN INERTIAL PLATFORM USING KALMAN FILTERING. FILTERREDUCTION AND SENSITIVITY ANALYSIS [SCHNELLE FEINAUSRICHTUNG EINER TRAEGHEITSPLATTFORM MITTELS KALMAN-FILTERUNG. FILTERREDUKTION UND EMPFINDLICHKEITSANALYSE]
Willi Kortuem and Rudolf Richter 5 Mar. 1976 65 p refs In GERMAN
(DLR-A-552-75/39) Avail: NTIS HC A04/MF A01

A Kalman filter was designed for an inertial platform based on observability and sensitivity analyses. Theoretical investigations are described concerning the fast alignment using Kalman filtering. They cover the following problems: order reduction of the filter based on observability analysis, respectively, the covariance behavior of the filter (self-diagnosis) and covariance analysis (external diagnosis) of the proposed filter by analysis of a linear order system and accounting for parameter variations. A general computer program was developed for the covariance analysis of filters. ESA

N77-10042# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.
RESULTS OF TESTS FOR DETERMINATION OF THE MAXIMUM DETECTION RANGE IN OBSERVING AIRCRAFT FROM THE GROUND IN NORTHERN GERMANY [ERGEBNISSE VON VERSUCHEN ZUR BESTIMMUNG DER MAXIMALEN AUFFASSREICHWEITE BEI DER BEOBACHTUNG VON LUFTFAHRZEUGEN VOM BODEN AUS IN NORDDEUTSCHLAND]
H.-E. Hoffmann and R. H. Buell Dec. 1974 48 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung
(DLR-IB-553-74/4) Avail: NTIS HC A03/MF A01

During the Haven View 2 project tests were also carried out to determine the maximum detection range in observing aircraft from the ground. How the type of approaching aircraft (Do-27, C-160 (Transall), H-34 (Bell)), the flight level, and the angle of azimuth between observation direction and sun influence the maximum detection range was investigated. At standard horizontal visibilities between 32 and 66 km a C-160 was detected up to 14 km farther than a Do-27. At flight levels of about 4000 ft the maximum detection range could exceed that of flight levels of about 0 ft up to 14 km. Approaching at an angle of azimuth between observation direction and sun larger than 100 deg, the aircraft were usually detected earlier than at an angle of azimuth smaller than 50 deg. Values for the maximum detection range at horizontal standard visibilities greater than 60 km roughly corresponded with results previously found. Author (ESA)

N77-10043# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
COMPARISON OF LOW-COST COMPUTER ALGORITHMS FOR GLOBAL POSITIONING SYSTEM USERS M.S. Thesis
John C. Chapman, Jr. Mar. 1976 87 p refs
(AD-A022989; GA/MC/76M-1) Avail: NTIS HC A05/MF A01 CSCL 17/7

The Global Positioning System (GPS) is a navigation system which relies on range and range-rate measurements between satellites and the GPS-user in order to determine his position and velocity. Using extensive support equipment, GPS is anticipated to achieve extremely accurate results. However, since many users will not require high accuracies, this study compares the performance of three simulated computer algorithms for possible low-cost use. The three approaches to processing the measurement information are (1) a direct solution of the nonlinear measurement equations, (2) linearization of the equations prior to solution, and (3) a Kalman filter solution based on the linearized model. Velocity information was used to continually update position estimates (dead-reckoning) for the first two approaches. The Kalman filter was modelled with fixed covariance matrices. The approaches were tested against a 'real world' dynamic example (C5A) flight simulation, with error sources (receiver errors, atmospheric delay errors, etc.) modelled as Gaussian white sequences. GRA

N77-10383*# Youngstown State Univ., Ohio.
TERMINAL AREA GUIDANCE ALONG CURVED PATHS: A STOCHASTIC CONTROL APPROACH
J. E. Quaranta and R. H. Foulkes, Jr. *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1767-1777 refs
(For primary document see N77-10345 01-31)
(Grant NsG-1199)
Avail: NTIS HC A22/MF A01

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*

N77-10044*# United Technologies Research Center, East Hartford, Conn.
INVESTIGATION OF A BEARINGLESS HELICOPTER ROTOR CONCEPT HAVING A COMPOSITE PRIMARY STRUCTURE Final Report
Richard L. Bielawa, Marvin C. Cheney, Jr., and Richard C. Novak Oct. 1976 253 p refs
(Contract NAS1-10960; DA Proj. 1F1-61102-AH-45)
(NASA-CR-2637; R76-911209-47) Avail: NTIS HC A12/MF A01 CSCL 01C

Experimental and analytical investigations were conducted to evaluate a bearingless helicopter rotor concept (CBR) made possible through the use of the specialized nonisotropic properties of composite materials. The investigation was focused on four principal areas which were expected to answer important questions regarding the feasibility of this concept. First, an examination of material properties was made to establish moduli, ultimate strength, and fatigue characteristics of unidirectional graphite/epoxy, the composite material selected for this application. The results confirmed the high bending modulus and strengths and low shear modulus expected of this material, and demonstrated fatigue properties in torsion which make this material ideally suited for the CBR application. Second, a dynamically scaled model was fabricated and tested in the low speed wind tunnel to explore the aeroelastic characteristics of the CBR and to explore various concepts relative to the method of blade pitch control. Two basic control configurations were tested, one in which pitch flap coupling could occur and another which eliminated all coupling. It was found that both systems could be operated

successfully at simulated speeds of 180 knots; however, the configuration with coupling present revealed a potential for undesirable aeroelastic response. The uncoupled configuration behaved generally as a conventional hingeless rotor and was stable for all conditions tested. Author

N77-10045*# Lockheed-Georgia Co., Marietta.
AN ANALYTICAL STUDY FOR SUBSONIC OBLIQUE WING TRANSPORT CONCEPT
Edward S. Bradley, J. Honrath, K. H. Tomlin, G. Swift, P. Shumpert, and W. Warnock Jul. 1976 219 p refs
(Contract NAS2-8686)
(NASA-CR-137896; LG76ER0156) Avail: NTIS HC A10/MF A01 CSCL 01C

The oblique wing concept has been investigated for subsonic transport application for a cruise Mach number of 0.95. Three different mission applications were considered and the concept analyzed against the selected mission requirements. Configuration studies determined the best area of applicability to be a commercial passenger transport mission. The critical parameter for the oblique wing concept was found to be aspect ratio which was limited to a value of 6.0 due to aeroelastic divergence. Comparison of the concept final configuration was made with fixed winged configurations designed to cruise at Mach 0.85 and 0.95. The crossover Mach number for the oblique wing concept was found to be Mach 0.91 for takeoff gross weight and direct operating cost. Benefits include reduced takeoff distance, installed thrust and mission block fuel and improved community noise characteristics. The variable geometry feature enables the final configuration to increase range by 10% at Mach 0.712 and to increase endurance by as much as 44%. Author

N77-10046*# Lockheed-Georgia Co., Marietta.
AN ANALYTICAL STUDY FOR SUBSONIC OBLIQUE WING TRANSPORT CONCEPT
Edward S. Bradley Jul. 1976 37 p refs
(Contract NAS2-8686)
(NASA-CR-137897; LG76ER0156) Avail: NTIS HC A03/MF A01 CSCL 01C
For abstract, see N77-10045.

N77-10047*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Research and Development Div.
CIVIL USES OF REMOTELY PILOTED AIRCRAFT Final Report
Jon R. Aderhold, G. Gordon, and George W. Scott Jul. 1976 326 p refs
(Contract NAS2-8935)
(NASA-CR-137894; LMSC-D057323) Avail: NTIS HC A15/MF A01 CSCL 01C

The technology effort is identified and assessed that is required to bring the civil uses of RPVs to fruition and to determine whether or not the potential market is real and economically practical, the technologies are within reach, the operational problems are manageable, and the benefits are worth the cost. To do so, the economic, technical, and environmental implications are examined. The time frame is 1980-85. Representative uses are selected; detailed functional and performance requirements are derived for RPV systems; and conceptual system designs are devised. Total system cost comparisons are made with non-RPV alternatives. The potential market demand for RPV systems is estimated. Environmental and safety requirements are examined, and legal and regulatory concerns are identified. A potential demand for 2,000-11,000 RPV systems is estimated. Typical cost savings of 25-35% compared to non-RPV alternatives are determined. There appear to be no environmental problems, and the safety issue appears manageable. Author

N77-10048*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Research and Development Div.
CIVIL USES OF REMOTELY PILOTED AIRCRAFT Summary Report
Jon R. Aderhold, G. Gordon, and George W. Scott Jul. 1976 28 p ref
(Contract NAS2-8935)
(NASA-CR-137895; LMSC-D057322) Avail: NTIS HC A03/MF A01 CSCL 01C

The economic, technical, and environmental implications of remotely piloted vehicles (RVP) are examined. The time frame is 1980-85. Representative uses are selected; detailed functional and performance requirements are derived for RPV systems; and conceptual system designs are devised. Total system cost comparisons are made with non-RPV alternatives. The potential market demand for RPV systems is estimated. Environmental and safety requirements are examined, and legal and regulatory concerns are identified. A potential demand for 2,000-11,000 RVP systems is estimated. Typical cost savings of 25 to 35% compared to non-RPV alternatives are determined. There appear to be no environmental problems, and the safety issue appears manageable. Author

N77-10049*# Kanner (Leo) Associates, Redwood City, Calif.
CRITICAL ANALYSIS OF COMPARISONS BETWEEN FLIGHT TEST RESULTS AND WIND TUNNEL TEST PREDICTIONS IN SUBSONIC AND SUPERSONIC TRANSPORT AIRCRAFT
C. Pelagatti, J. C. Pilon, and J. Bardaud Washington NASA Aug. 1976 56 p refs Transl. into ENGLISH of French report AGARD-CP-187, Apr. 1976 Presented at the 46th Meeting of the Flight Mech. Panel, Valloire, France, 9-13 Jun. 1975
(Contract NASw-2790)
(NASA-TT-F-17185; AGARD-CP-187) Avail: NTIS HC A04/MF A01 CSCL 01C

In relating test results obtained from wind tunnels to results from actual flight tests, corrections must be made to allow for aeroelastic effects and the effect of Reynolds' number differences. Using data from Concorde and airbus tests, an attempt is made to define what degree of accuracy may be expected from aerodynamic coefficients derived from wind tunnel measurements. Author

N77-10050# Poitiers Univ. (France).
BUFFETING PROBLEMS [PROBLEMES DE BUFFETING]
J. Tensi and P. Perrier (Avions Marcel Dassault-Breguet Aviation) Paris Assoc. Aeron. et Astronautique de France 1976 48 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-7; ISBN-2-7170-0385-1) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

Wind tunnel studies of buffeting of two types of profiles in incompressible flow are presented: leading edge separation NACA 65 (sub 1)012 and trailing edge separation NACA 65 (sub 3) 618. The tests were made in the wind tunnel T sub 5 P sub 0 of the return (Prandtl) and guide vane type at 40 m/s. Results of the two tests are detailed and compared. It is shown that with the equipment used it is possible to determine the angle of attack and Reynolds number at which flow separation occurs. Also the separation progress with increasing angle of attack can be followed. ESA

N77-10051# Conservatoire National des Arts et Metiers, Paris (France).
NEW BUFFETING ACQUISITION METHODS [NOUVELLES METHODES D'ACQUISITION DE BUFFETING]
E. Gaignebet and G. Heckmann (Avions Marcel Dassault-Breguet Aviation) Assoc. Aeron. et Astronautique de France 1976 44 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-8; ISBN-2-7170-0386-X) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

A new method for military aircraft buffeting data acquisition, using wind tunnel tests, is presented. The data analysis principle is discussed and inertia measurements are detailed. The characteristics of the aircraft model are given and the data acquisition and data processing aspects are dealt with in detail. It is concluded that, with the hypothesis of small displacement, the use of six accelerometers is justified: any two of the three accelerometers related to one direction produce comparable results. ESA

N77-10052# European Space Agency, Paris (France).
THREE-COMPONENT MEASUREMENTS ON A MODEL OF A LIGHT STOL AIRCRAFT WITH CHORDWISE BLOWING
Horst Koerner et al May 1976 22 p refs Transl. into ENGLISH of "Dreikomponentenmessungen am Modell eines leichten STOL-Flugzeugs mit Ausblasen in Fluegeltiefenrichtung", DFVLR, Brunswick Report DLR-FB-75-74, 7 Nov. 1975 Original German report available from DFVLR, Cologne DM 10.20
(ESA-TT-299; DLR-FB-75-74) Avail: NTIS HC A02/MF A01

Investigations on a STOL aircraft with internally blown flaps are described. To avoid separation on the wing, slots were located behind the nose flap and in front of the trailing edge flap. The investigations were designed to examine maximum lift and lift/drag ratio. In addition, the effectiveness of the aileron and the horizontal tail were investigated. Author (ESA)

N77-10366*# Lockheed-Georgia Co., Marietta.
DESIGN CONSIDERATIONS FOR LAMINAR FLOW CONTROL AIRCRAFT
R. F. Sturgeon and J. A. Bennett *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1539-1548 refs (For primary document see N77-10345 01-31)
(Contract NAS1-13694)
Avail: NTIS HC A22/MF A01

N77-10367*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
ON THE STATUS OF V/STOL FLIGHT
Barnes W. McCormick *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1549-1562 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

N77-10379*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
BEST-RANGE FLIGHT CONDITIONS FOR CRUISE-CLIMB FLIGHT OF A JET AIRCRAFT
Francis J. Hale *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1713-1719 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

No abstracts in this category.

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N77-10053# United Technologies Corp., Windsor Locks, Conn.
V/STOL ROTARY PROPULSION SYSTEMS: NOISE PREDICTION AND REDUCTION. VOLUME 1: IDENTIFICATION OF SOURCES, NOISE GENERATING MECHANISMS, NOISE REDUCTION MECHANISMS, AND PREDICTION METHODOLOGY Final Report
B. Magliozzi May 1976 143 p refs
(Contract DOT-FA74WA-3477)
(AD-A027389/6; FAA-RD-76-49-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 01/3

The propulsion systems of current and future V/STOL vehicles can be defined as combinations of free air propellers, shrouded propellers, variable pitch fans, fixed pitch fans, tilt rotors, helicopter rotors, lift fans, gearboxes, and drive engines. Noise sources for each of these propulsors, gearboxes, and drive engines are identified and rank ordered. The noise generating mechanisms for each of the propulsor noise sources identified are defined and systematically catalogued. Three approaches to reduction of propulsor noise are discussed: changes in physical geometry, changes in design operating conditions, and the use of acoustic treatments. Computerized and graphical procedures based on methodology from the open literature are presented for predicting aerodynamic performance of and noise from the V/STOL propulsors. The developed methodology allows the user to estimate the achieved noise reduction as well as the incurred performance penalties of noise reduction design features and noise attenuation devices such as partly sonic inlets and acoustic treatment. Much of the noise generating mechanism substantiation data and prediction methodology are based on static operation. Forward flight effects have recently been recognized as having a significant effect on the noise sources. Forward flight effect corrections are included in the methodology. Author

N77-10054# United Technologies Corp., Windsor Locks, Conn.
V/STOL ROTARY PROPULSION SYSTEMS: NOISE PREDICTION AND REDUCTION. VOLUME 2: GRAPHICAL PREDICTION METHODS Final Report
B. Magliozzi May 1976 304 p refs 3 Vol.
(Contract DOT-FA74WA-3477)
(AD-A027390/4; FAA-RD-76-49-Vol-2) Avail: NTIS HC A13/MF A01 CSCL 01/3

Graphical procedures for estimating noise and performance of free air propellers, variable pitch fans with inlet guide vanes, variable pitch fans with outlet guide vanes, fixed pitch fans, helicopter rotors, tilt rotors, and lift fans are presented. Noise prediction methods for drive engines, gearboxes, jets with and without bypass flow, as well as noise reduction and performance losses for partly sonic inlets and duct linings are also presented. The procedures are extensive and applicable to a wide variety of V/STOL propulsor systems, including present and future V/STOL vehicles. The methods have been validated with available data wherever possible. However, high quality data for isolated propulsors which are free from contamination by other sources and ground reflections are somewhat limited, particularly for forward flight conditions. Author

N77-10055# United Technologies Corp., Windsor Locks, Conn.
V/STOL ROTARY PROPULSION SYSTEMS: NOISE PREDICTION AND REDUCTION. VOLUME 3: COMPUTER PROGRAM USERS MANUAL Final Report
B. Magliozzi May 1976 302 p refs
(Contract DOT-FA74WA-3477)
(AD-A027363/1; FAA-RD-76-49-Vol-3) Avail: NTIS HC A14/MF A01 CSCL 01/3

A computer program is presented which allows a user to make performance and far field acoustic noise predictions for free air propellers, variable pitch fans with inlet guide vanes, variable pitch fans with outlet guide vanes, fixed pitch fans, helicopter rotors, tilt rotors, fixed pitch lift vanes with remote, integral, and tip turbine drives, and variable pitch lift fans with remote and integral drives. Noise prediction methodology for drive engines, single stream and coaxial jets, and gearboxes is also included, as well as noise reduction and performance losses of partly sonic inlets and duct acoustic treatment. A description of the program, detailed instructions for its use, required inputs, and sample cases are presented. Author

N77-10056*# Ellco Engineering, Inc., Compton, Calif.
TRANSONIC PERFORMANCE OF MACH 2.65 AUXILIARY FLOW AXISYMMETRIC INLET Final Report
Don M. Santman Oct. 1976 63 p refs
(Contract NAS2-8679)
(NASA-CR-2747) Avail: NTIS HC A04/MF A01 CSCL 21E

Transonic experimental performance for a large scale Mach 2.65 axisymmetric inlet model with auxiliary airflow systems are presented. The inlet model incorporated both centerbody and cowl auxiliary airflow systems. When the centerbody system was fully open the performance at the simulated compressor face

was such that, at 0.10 total pressure distortion the total capture mass flow ratio increased 0.055 and 0.051 and the total pressure recovery increased 0.015 and 0.012 at Mach 0.9 and 1.3, respectively. Flow separation on the centerbody resulted in supercritical centerbody auxiliary throat flow prior to attainment of choked main duct throat flow. Cowl auxiliary airflow had a detrimental effect on compressor-face performance. To overcome the detrimental effect, alternate cowl auxiliary airflow systems are described for efficient merging of auxiliary and main duct airflows and for providing similar auxiliary and main duct throat choking characteristics. Author

N77-10057*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TOWARD MORE ENVIRONMENTALLY RESISTANT GAS TURBINES: PROGRESS IN NASA-LEWIS PROGRAMS

Carl E. Lowell, Salvatore J. Grisaffe, and Stanley R. Levine 1976 24 p refs Presented at 3d Conf. on Gas Turbine Mater. in a Marine Environ., Bath, Engl., 20-23 Sep. 1976

(NASA-TM-X-73499) Avail: NTIS HC A02/MF A01 CSCL 21E

A wide range of programs are being conducted for improving the environmental resistance to oxidation and hot corrosion of gas turbine and power system materials. They range from fundamental efforts to delineate attack mechanisms, allow attack modeling and permit life prediction, to more applied efforts to develop potentially more resistant alloys and coatings. Oxidation life prediction efforts have resulted in a computer program which provides an initial method for predicting long time metal loss using short time oxidation data by means of a paralinear attack model. Efforts in alloy development have centered on oxide-dispersion strengthened alloys based on the Ni-Cr-Al system. Compositions have been identified which are compromises between oxidation and thermal fatigue resistance. Fundamental studies of hot corrosion mechanisms include thermodynamic studies of sodium sulfate formation during turbine combustion. Information concerning species formed during the vaporization of Na2SO4 has been developed using high temperature mass spectrometry. Author

N77-10058*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EMISSIONS OF AN AVCO LYCOMING 0-320-DIAD AIR COOLED LIGHT AIRCRAFT ENGINE AS A FUNCTION OF FUEL-AIR RATIO, TIMING, AND AIR TEMPERATURE AND HUMIDITY

Phillip R. Meng, Michael Skorobatckyi, Donald V. Cosgrove, and Erwin E. Kempke Aug. 1976 206 p refs

(NASA-TM-X-73500) Avail: NTIS HC A10/MF A01 CSCL 21G

A carbureted aircraft engine was operated over a range of test conditions to establish the exhaust levels over the EPA seven-mode emissions cycle. Baseline (full rich production limit) exhaust emissions at an induction air temperature of 59 F and near zero relative humidity were 90 percent of the EPA standard for HC, 35 percent for NOx, and 161 percent for CO. Changes in ignition timing around the standard 25 deg BTDC from 30 deg BTDC to 20 deg BTDC had little effect on the exhaust emissions. Retarding the timing to 15 deg BTDC increased both the HC and CO emissions and decreased NOx emissions. HC and CO emissions decreased as the carburetor was leaned out, while NOx emissions increased. The EPA emission standards were marginally achieved at two leanout conditions. Variations in the quantity of cooling air flow over the engine had no effect on exhaust emissions. Temperature-humidity effects at the higher values of air temperature and relative humidity tested indicated that the HC and CO emissions increased significantly, while the NOx emissions decreased. Author

N77-10059*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SUPERSONIC VARIABLE-CYCLE ENGINES

E. A. Willis and A. D. Welliver (Boeing Aerospace Co., Seattle, Wash.) 1976 11 p refs Presented at the 12th Propulsion Conf., Palo Alto, Calif., 26-29 Jul. 1976; cosponsored by AIAA and SAE

(NASA-TM-X-73524) Avail: NTIS HC A02/MF A01 CSCL 21E

The evolution and current status of selected recent variable cycle engine (VCE) studies are reviewed, and how the results were influenced by airplane requirements is described. Promising VCE concepts are described, their designs are simplified and the potential benefits in terms of aircraft performance are identified. This includes range, noise, emissions, and the time and effort it may require to ensure technical readiness of sufficient depth to satisfy reasonable economic, performance, and environmental constraints. A brief overview of closely related, ongoing technology programs in acoustics and exhaust emissions is also presented. Realistic technology advancements in critical areas combined with well matched aircraft and selected VCE concepts can lead to significantly improved economic and environmental performance relative to first generation SST predictions. Author

N77-10060*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.

COMPUTATIONAL ALTERNATIVES TO OBTAIN TIME OPTIMAL JET ENGINE CONTROL M.S. Thesis

R. J. Basso and R. J. Leake Oct. 1976 73 p refs

(Grant NsG-3048)

(NASA-CR-149106; EE-7611) Avail: NTIS HC A04/MF A01 CSCL 21E

Two computational methods to determine an open loop time optimal control sequence for a simple single spool turbojet engine are described by a set of nonlinear differential equations. Both methods are modifications of widely accepted algorithms which can solve fixed time unconstrained optimal control problems with a free right end. Constrained problems to be considered have fixed right ends and free time. Dynamic programming is defined on a standard problem and it yields a successive approximation solution to the time optimal problem of interest. A feedback control law is obtained and it is then used to determine the corresponding open loop control sequence. The Fletcher-Reeves conjugate gradient method has been selected for adaptation to solve a nonlinear optimal control problem with state variable and control constraints. Author

N77-10061*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.

SIMPLIFIED SIMULATION MODELS FOR CONTROL STUDIES OF TURBOJET ENGINES

Thomas C. Brennan and R. Jeffrey Leake Nov. 1975 93 p refs

(Grant NsG-3048)

(NASA-CR-149107; EE-757) Avail: NTIS HC A05/MF A01 CSCL 21E

The essential dynamical characteristics of a simple single spool turbojet engine were determined through simulation of low order system models on an analog computer. An accurate model was studied and system complexity was reduced through various linearizations and approximations. A derivation of a seventh order simplified simulation model is presented with a derivation of an even simpler third order model, and simulation results from each. The control problem studied is one of getting from zero fuel flow equilibrium to a high thrust equilibrium while taking into account surge margin and turbine inlet temperature constraints. Author

N77-10062*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ADVANCED COMBUSTION TECHNIQUES FOR CONTROLLING NO SUB x EMISSIONS OF HIGH ALTITUDE CRUISE AIRCRAFT

R. A. Rudey and G. M. Reck 1976 21 p refs Presented at 27th Intern. Astronaut. Congr., Anaheim, Calif., 10-16 Oct. 1976; sponsored by AIAA

(NASA-TM-X-73473; E-8858) Avail: NTIS HC A02/MF A01 CSCL 21E

An array of experiments designed to explore the potential of advanced combustion techniques for controlling the emissions of aircraft into the upper atmosphere was discussed. Of particular concern are the oxides of nitrogen (NOx) emissions into the stratosphere. The experiments utilize a wide variety of approaches varying from advanced combustor concepts to fundamental flame tube experiments. Results are presented which indicate that substantial reductions in cruise NOx emissions should be achievable in future aircraft engines. A major NASA program is

described which focuses the many fundamental experiments into a planned evolution and demonstration of the prevaporized-premixed combustion technique in a full-scale engine. Author

N77-10063*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE IMPACT OF EMISSIONS STANDARDS ON THE DESIGN OF AIRCRAFT GAS TURBINE ENGINE COMBUSTORS
Richard A. Rudey 1976 19 p refs Presented at the Aerospace Conf., San Diego, Calif., 29 Nov. - 2 Dec. 1976; sponsored by SAE
(NASA-TM-X-73490) Avail: NTIS HC A02/MF A01 CSCL 21E

Effective emission control techniques have been identified and a wide spectrum of potential applications for these techniques to existing and advanced engines are being considered. Results from advanced combustor concept evaluations and from fundamental experiments are presented and discussed and comparisons are made with existing EPA emission standards and recommended levels for high altitude cruise. The impact that the advanced low emission concepts may impose on future aircraft engine combustor designs and related engine components is discussed. Author

N77-10064*# Pratt and Whitney Aircraft, East Hartford, Conn.
EXPERIMENTAL CLEAN COMBUSTOR PROGRAM: NOISE STUDY
T. G. Sofrin and N. Riloff, Jr. Sep. 1976 191 p refs
(Contract NAS3-18544)
(NASA-CR-135106; PWA-5458) Avail: NTIS HC A09/MF A01 CSCL 21E

Under a Noise Addendum to the NASA Experimental Clean Combustor Program (ECCP) internal pressure fluctuations were measured during tests of JT9D combustor designs conducted in a burner test rig. Measurements were correlated with burner operating parameters using an expression relating farfield noise to these parameters. For a given combustor, variation of internal noise with operating parameters was reasonably well predicted by this expression but the levels were higher than farfield predictions and differed significantly among several combustors. For two burners, discharge stream temperature fluctuations were obtained with fast-response thermocouples to allow calculation of indirect combustion noise which would be generated by passage of the temperature inhomogeneities through the high pressure turbine stages of a JT9D turbofan engine. Using a previously developed analysis, the computed indirect combustion noise was significantly lower than total low frequency core noise observed on this and several other engines. Author

N77-10065*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ASSESSMENT OF VARIABLE-CYCLE ENGINES FOR MACH 2.7 SUPERSONIC TRANSPORTS Status Report
S. J. Morris, W. E. Foss, Jr., and J. W. Russell (Vought Corp., Hampton, Va.) 1 Nov. 1976 59 p refs
(NASA-TM-X-73977) Avail: NTIS HC A04/MF A01 CSCL 21E

Three proposed SCAR propulsion systems in terms of aircraft range for a fixed payload and take-off gross weight with a design cruise Mach number 2.7 are evaluated. The effects of various noise and operational restraints are determined and sensitivities to some of the more important performance variables are presented for the most probable design noise and operational restraint case. Critical areas requiring new or improved technology for each cycle are delineated. Author

N77-10066*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF AIR TEMPERATURE AND RELATIVE HUMIDITY AT VARIOUS FUEL-AIR RATIOS ON EXHAUST EMISSIONS ON A PER-MODE BASIS OF AN AVCO LYCOMING 0-320 DIAD LIGHT AIRCRAFT ENGINE. VOLUME 2: INDIVIDUAL DATA POINTS
Michael Skorobatckyi, Donald V. Cosgrove, Phillip R. Meng, and Edward R. Kempke Sep. 1976 850 p
(NASA-TM-X-73507; E-8916-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 21E

A carbureted four cylinder air cooled 0-320 DIAD Lycoming aircraft engine was tested to establish the effects of air temperature and humidity at various fuel-air ratios on the exhaust emissions on a per-mode basis. The test conditions included carburetor lean-out at air temperatures of 50, 59, 80, and 100 F at relative humidities of 0, 30, 60, and 80 percent. Temperature-humidity effects at the higher values of air temperature and relative humidity tested indicated that the HC and CO emissions increased significantly, while the NOx emissions decreased. Even at a fixed fuel-air ratio, the HC emissions increase and the NOx emissions decrease at the higher values of air temperature and humidity. Volume II contains the data taken at each of the individual test points. Author

N77-10067# Technische Hochschule, Aachen (West Germany). Inst. fuer Luft- und Raumfahrt.
NOISE GENERATING BY INTERACTION BETWEEN SUBSONIC JETS AND BLOWN FLAPS
Erich Evertz, Valentin Kloeppel, Guenther Neuwerth, and August Wilhelm Quick Cologne DFVLR 15 Mar. 1976 23 p refs Presented at AIAA Meeting, Tenn. Sponsored by Min. fuer Wiss. u. Forsch. des Landes Nordrhein-Westfalen
(DLR-FB-76-20) Avail: NTIS HC A02/MF A01; DFVLR, Cologne DM 10.80

On the basis of experimental results the strong noise generation originating from the interference between air jets of high subsonic speed and externally blown flaps (EBF) is discussed. It is shown that, in an undisturbed free jet as well as in a jet deflected by EBF, there are ordered turbulence structures. An acoustical feedback mechanism which develops at small distances between nozzle and stagnation point on the flaps and which reinforces the turbulence structures is explained. It is subsequently shown that even without acoustic feedback both the undisturbed free jet and the jet deflected by EBF have their maximum noise levels at the Strouhal number of the natural ordered structures. Author (ESA)

N77-10068# Naval Air Systems Command, Washington, D.C.
PREDICTION METHODS FOR JET V/STOL PROPULSION AERODYNAMICS, VOLUME 1
M. F. Platzer Jul. 1975 541 p refs Workshop held at Arlington, Va., 28-31 Jul. 1975
(AD-A024022) Avail: NTIS HC A23/MF A01 CSCL 01/1

High speed V/STOL aircraft operating from widely dispersed platforms have become of increasing interest to the U.S. Navy. The dispersed force concept requires a well developed technology base, involving phenomena and problems which do not occur on conventional aircraft or low speed V/STOL craft. Proper design must account for the interdependence of aerodynamic and propulsion phenomena, and flows so complex that purely theoretical prediction is precluded at present. A two-volume report is made on a 1975 workshop to study these interactions. GRA

N77-10069# Naval Air Systems Command, Washington, D.C.
PREDICTION METHODS FOR JET V/STOL PROPULSION AERODYNAMICS, VOLUME 2
M. F. Platzer Jul. 1975 545 p refs Workshop held at Arlington, Va., 28-31 Jul. 1975
(AD-A024023) Avail: NTIS HC A23/MF A01 CSCL 01/1
For abstract, see N77-10068

N77-10070# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
COMBUSTOR DESIGN FOR LOW COST EXPENDABLE TURBOJETS M.S. Thesis
Raymond L. Greene Mar. 1976 57 p refs
(AD-A024541; GAE/AE/76M-1) Avail: NTIS HC A04/MF A01 CSCL 21/5

The development of two experimental burners was completed as part of a project to evaluate the suitability of the use of converted reciprocating engine turbochargers as expendable jet engines for remotely piloted vehicles. As a result of analytic studies, Burner 'A' was constructed as a reverse flow burner and was designed to accept a mass flow up to 0.75 lbm/sec. Burner 'B' was also reverse and designed for a mass flow up to 1.5 lbm/sec. Both burners operated successfully on their respective turbochargers. GRA

N77-10372*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYDROGEN-FUELED SCRAMJETS: POTENTIAL FOR DETAILED COMBUSTOR ANALYSIS
H. L. Beach, Jr. *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1629-1639 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 21A

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N77-10377*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESIGN OF ACTIVE CONTROLS FOR THE NASA F-8 DIGITAL FLY-BY-WIRE AIRPLANE
Joseph Gera *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1687-1701 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 01C

N77-10378*# Aerospace Systems, Inc., Burlington, Mass.
PERFORMANCE ANALYSIS OF FLEXIBLE AIRCRAFT WITH ACTIVE CONTROL
Richard B. Noll and Luigi Morino (Boston Univ.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1703-1711 refs (For primary document see N77-10345 01-31)
(Contract NAS1-13371)
Avail: NTIS HC A22/MF A01

N77-10381*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESULTS OF RECENT NASA STUDIES ON AUTOMATIC SPIN PREVENTION FOR FIGHTER AIRCRAFT
Joseph R. Chambers and Luat T. Nguyen *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1733-1751 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 01C

N77-10382*# Analytic Sciences Corp., Washington, D.C.
HIGH ANGLE-OF-ATTACK STABILITY-AND-CONTROL ANALYSIS
Robert F. Stengel *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1753-1766 refs (For primary document see N77-10345 01-31)
(Contracts NAS1-13618; N00014-75-C-0432)
Avail: NTIS HC A22/MF A01

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N77-10071* National Aeronautics and Space Administration. Pasadena Office, Calif.
ANNULAR ARC ACCELERATOR SHOCK TUBE Patent
Lewis P. Leibowitz, inventor (to NASA) (JPL) Issued 5 Oct. 1976 9 p Filed 6 Nov. 1974 Supersedes N75-11997 (13 - 03, p 0261) Published under the second Trial Voluntary Protest Program as B521,620, 27 Jan. 1976 Sponsored by NASA
(NASA-Case-NPO-13528-1; US-Patent-3,983,749; US-Patent-Appl-SN-521620; US-Patent-Class-73-147) Avail: US Patent Office CSCL 14B

An annular arc accelerator shock tube employs a cold gas driver to flow a stream of gas from an expansion section through a high voltage electrode section to a test section, thus driving a shock wave in front of it. A glow discharge detects the shock wave and actuates a trigger generator which in turn fires spark-gap switches to discharge a bank of capacitors across a centered cathode and an annular anode in tandem electrode sections. The initial shock wave passes through the anode section from the cathode section thereby depositing energy into the flow gas without the necessity of any diaphragm opening in the gas flow from the expansion section through the electrode sections. Official Gazette of the U.S. Patent Office

N77-10072*# Massachusetts Inst. of Tech., Cambridge.
SURVEY OF THE POTENTIAL LDEF USER COMMUNITY AT MIT Final Report
Joseph H. Binsack 29 Oct. 1976 35 p refs
(Grant NsG-1299)
(NASA-CR-148461) Avail: NTIS HC A03/MF A01 CSCL 14B

The potential Long Duration Exposure Facility (LDEF) user community was examined in order to help formulate concepts for the proper utilization of the LDEF during its expected operational phase. The importance of the evolution of the LDEF from a passive structure suited primarily to technological experiments, toward an active platform from which significant astrophysical, applications, and other scientific experiments can be conducted is emphasized. Author

N77-10073*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A HIGH PRESSURE, HIGH TEMPERATURE COMBUSTOR AND TURBINE-COOLING TEST FACILITY
Reeves P. Cochran and James W. Norris 1976 30 p refs Presented at Winter Ann. Meeting of the Am. Soc. of Mechanical Engineers, New York, 28 Nov. - 3 Dec. 1976
(NASA-TM-X-73445; E-8801) Avail: NTIS HC A03/MF A01 CSCL 14B

A new test facility is being constructed for developing turbine-cooling and combustor technology for future generation aircraft gas turbine engines. Prototype engine hardware will be investigated in this new facility at gas stream conditions up to 2480 K average turbine inlet temperature and 4.14 x 10 to the 6th power n sq m turbine inlet pressure. The facility will have the unique feature of fully automated control and data acquisition through the use of an integrated system of mini-computers and programmable controllers which will result in more effective use of operating time, will limit the number of operators required, and will provide built in self protection safety systems. The facility and the planning and design considerations are described.
Author

N77-10074# Sandia Labs., Albuquerque, N.Mex.
ACCELERATION OF FLYER PLATES BY ELECTRICALLY EXPLODED FOILS
P. L. Stanton Jan. 1976 41 p refs
(Contract AT(29-1)-789)
(SAND-75-0221) Avail: NTIS HC A03/MF A01

Metal foils, exploded by a pulse of high density electric current, can be used to accelerate thin plastic flyers to velocities of 8 km/s or greater. The behavior of these devices was investigated analytically and experimentally. The results of hydrodynamic computer code simulations are shown to be in good agreement with experimental measurements of the flyer velocity. Author (ERA)

N77-10075# National Swedish Road and Traffic Research Inst., Stockholm.
THE EFFECT OF SPRING THAW SUBGRADE CONDITIONS ON THE LOAD-CARRYING CAPABILITY OF FLEXIBLE AIRFIELD PAVEMENTS IN COLD REGIONS
Bjoern Oerbom 1975 19 p refs
(VTI-60-A) Avail: NTIS HC A03/MF A01

The seasonal variation of the strength of a normally designed flexible runway pavement in climatic conditions like those of Scandinavia was studied. Based on results from falling weight deflectometer tests on two test sections with frost-susceptible subgrade, the strains on the bituminous pavement and the subgrade were computed. The annual failure ratios - defined as the numbers of strain applications caused by a repeated invariable load in relation to the total number of strain applications causing fatigue failure - for the different seasons of the year

and for every load applied were calculated. From the derived seasonal variation of the annual failure ratio for the pavement chosen, two conclusions were drawn: (1) if the bearing capacity is to be expressed in one single safe load holding good for the whole year, the level of the load is to a very great extent determined by the comparatively high annual failure ratio for the spring thaw period; (2) by choosing a somewhat lower safe load for the spring thaw period, which for the circumstances in question is a small part of the year, it will be possible to increase substantially the safe load for the rest of the year. Author (ESA)

N77-10076# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Aerodynamik.

DETERMINATION OF WIND TUNNEL TURBULENCE IN THE TANDEM TEST SECTIONS OF THE MODEL SUBSONIC WIND TUNNEL FOR THE LARGE SUBSONIC WIND TUNNEL (GUK) [ERMITTLUNG DER WINDKANALTURBULENZ IN DEN TANDEMMESSTRECKEN DES MODELL-UNTERSCHALLWINDKANALS ZUM GUK]

N. Schmidt Dec. 1975 46 p refs In GERMAN
(DLR-IB-151-75/18) Avail: NTIS HC A03/MF A01

Partial results concerning turbulence measurements for the design of a large subsonic wind tunnel are presented. The results for the turbulence intensities in the three coordinate directions and for the degree of turbulence are given in tables and graphs, and a frequency analysis of the turbulence signal is discussed. The velocity in the center point of each test section varied and measurements were carried out in the vertical cross section for constant wind velocity in a raster of 5 by 5 test points, covering 80% of the section's width and height. In addition, measurements were carried out at two points on the tunnel axis in front of and behind the center point. The test conditions and the hot-wire anemometry applied are described. ESA

N77-10077# Association Aeronautique et Astronautique de France, Paris.

APPLICATION OF PERMEABLE WALLS TO TRANSONIC WIND TUNNEL SEGMENTS [APPLICATION DE PAROIS PERMEABLES AUX VEINES DE SOUFFLERIES TRANSSONIQUES]

J. Fournier, R. Leblanc (Poitiers Univ., France), and J. C. Vayssaire (Avions Marcel Dassault-Breguet Aviation) 1976 44 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975 Sponsored by Service Tech. Aeron.
(AAAF-NT-76-2; ISBN-2-7170-0380) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

A simplified theoretical analysis and experimental verifications at M = 1.43 of the possibility of avoiding, by aspiration, reflection of a shock wave on a porous wind tunnel wall are presented. The linearized theory is recalled briefly; a generalized expression for the Rayl's number is given; and a simplified theory - without viscous effects - permitting the calculation of wall characteristics as a function of Mach number and angle of attack is developed. Tests were made at M = 1.43 for angles of attack of 1.5, 2.5, 3, and 3.5 deg for different wall types (plastic, boron, or boron and glass fiber) and for various aspiration rates. It is shown that reflection of shock waves can be avoided completely. The noise at the floor opposite the porous wall was also measured. ESA

N77-10078# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).

WALL CORRECTION METHODS WITH EXPERIMENTAL APPLICATIONS [METHODES DE CORRECTION DE PAROIS AVEC APPLICATIONS EXPERIMENTALES]

J. C. Vayssaire Paris Assoc. Aeron. et Astronautique de France 1976 56 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-3; ISBN-2-7170-0381-9) Avail: NTIS HC A04/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

Methods to obtain the correction factors at any point in a wind tunnel, notably the vortex lattice method, are discussed. The vortex lattice method, the difficulties of which are explained, is validated by comparison with results from other methods, such as those obtained from images, which allow calculation of correction factors at right angles with the airfoil only. Wind tunnel shapes with negligible wall effects are proposed. Experimental results, which also validate the vortex lattice method, allow the determination of correction factors with semi-empirical methods in the special case of flow separation. A complete correction program, for wind tunnels with ventilated walls up to the high subsonic range, is presented. ESA

N77-10079# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).

CONCEPT AND DESIGN OF AN INJECTION PRESSURIZED TRANSONIC WIND TUNNEL [ETUDE DES PROBLEMES LIES A LA DEFINITION ET A LA MISE AU POINT D'UNE SOUFFLERIE TRANSSONIQUE PRESSURISEE A INDUCTION]

C. Quemard, A. Mignosi, and J. L. Gobert Paris Assoc. Aeron. et Astronautique de France 1976 12 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-9; ISBN-2-7170-0387-8) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

An injector pressurized wind tunnel, which represents at a scale of 1/10 the project proposed by ONERA for a very high Reynolds number transonic facility, was built and is operating at the Aerothermodynamics Department of ONERA-CERT at Toulouse. The tunnel is described, as well as the results obtained from studies on the functioning of an injection tunnel, a study which was also carried out on a smaller size pilot installation and which was concerned with determination and optimization of performances in permanent regime, flow quality (pressure and velocity fluctuations), and analysis of unsteady phenomena during the wind tunnel startup. Author (ESA)

N77-10080# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

SELF CORRECTING WALLS FOR A TRANSONIC WIND TUNNEL

Jean-Pierre Chevallier Assoc. Aeron. et Astronautique de France 1976 22 p refs In FRENCH; ENGLISH summary Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-10; ISBN-2-7170-0388-6) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

The concept of self correcting walls to remedy the difficulties of application of wall correction effects in high transonic flow with nonlinear phenomena is discussed. The method involves active control of the perturbation component normal to the wall, based on the iterative calculation of the virtual flow in an unlimited domain outside the tunnel section. The principle and the means of application of the new testing process are dealt with and the preliminary study of a pilot facility and the first results obtained in two-dimensional flow are presented. Author (ESA)

N77-10081# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

TRANSONIC WALL CORRECTIONS [CORRECTIONS DE PAROIS EN TRANSSONIQUE]

Xavier Vaucheret Assoc. Aeron. et Astronautique de France 1976 29 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-11; ISBN-2-7170-0389-4) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

A method for the correction for wall effects in transonic wind tunnels is discussed. The necessity of applying such corrections is detailed, and an analytical method for the calculation of the correction coefficients is given. The method was developed at ONERA for the three-dimensional case. The experimental determination of the wall porosity from reference tests is discussed and a mathematical law defining the aerodynamic permeability as a function of Mach number and generating pressure of the S2 wind tunnel at Modane was derived. ESA

N77-10082# Office National d'Etudes et de Recherches Aerospatiales, Modane (France).
NOISE AND TURBULENCE IN TRANSONIC WIND TUNNELS [BRUIT ET TURBULENCE EN SOUFFLERIE TRANSSONIQUE]
Michel Canu Paris Assoc. Aeron. et Astronautique de France 1976 21 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-12; ISBN-2-7170-0390-8) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

Reduction of noise in transonic wind tunnels, due largely to wall perforations, was studied. Different types of perforations were tested. Several of these bring the noise level down to that of guide vanes. The measurements were made with microphones or with hot wire probes; from the analogy of the spectra obtained it was concluded that noise is the major component of the turbulence. ESA

N77-10083# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
INFLUENCE OF WIND TUNNEL WALL BOUNDARY LAYERS ON TWO DIMENSIONAL TRANSONIC TESTS
Rene Bernard-Guelle Assoc. Aeron. et Astronautique de France 1976 24 p refs In FRENCH; ENGLISH summary Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-13; ISBN-2-7170-0391-6) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

Wind tunnel tests on the aspiration of the boundary layer upstream of the reference profiles NACA 0012 and LC 100D are discussed. The two-dimensional test section of the ONERA RICh wind tunnel contains a porous wall permitting partial aspiration of the boundary layer upstream of the model. The aspiration rate is adjustable and generates a variation of the displacement thickness from 5 to 1% of the model half-span, permitting in some cases the extrapolation of the results to the extreme case of no boundary layer. The effect of wall boundary layers appears as a variation of the profile performance and a displacement of the shock waves. To compare the results obtained in various wind tunnels, this parameter should be taken into consideration. It appears very difficult to establish a method for correcting these wall boundary layer effects, therefore it seems mandatory to reduce them as far as possible. Author (ESA)

N77-10084# Institut de Mecanique des Fluides de Lille (France).
IMPROVEMENT OF THE TWO-DIMENSIONALITY OF A TRANSONIC WIND TUNNEL FLOW [AMELIORATION DE LA BIDIMENSIONNALITE DE L'ECOULEMENT DANS UNE VEINE TRANSSONIQUE]
A. Dyment and P. Gryson Paris Assoc. Aeron. et Astronautique de France 1976 24 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-18) Avail: NTIS HC A02/MF A01; CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

The possibility of reducing - by lateral aspiration - the effect of the boundary layers and flow separation near the lateral walls of a transonic wind tunnel was investigated with a view to obtaining an undisturbed two-dimensional flow. The lateral aspiration was applied upstream of the model. Some test results are presented and a comparison with wind tunnels bigger than the one used at I.M.F. Lille (France) was made. It is shown that the lateral wall effects could be reduced substantially. ESA

N77-10085# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
MOBILE LOUNGE DESIGN WITH CHECK-IN, PASSPORT CONTROL AND BAGGAGE-HOLD FACILITIES
D. Bennetts, N. M. Hawkins, P. D. McGinity, M. OLeary, and N. Ashford Aug. 1975 40 p refs Sponsored by Sci. Res. Council
(TT-7512) Avail: NTIS HC A03/MF A01

The design, criteria, requirements, and structure of a new mobile lounge concept which incorporates check-in, baggage hold, immigration, and passport control facilities in the vehicle are described. The mobile lounge is designed to plug into, and expand, terminal building facilities during passenger peak periods. First level design considerations proposed for the mobile lounge appear to meld satisfactorily with little design requirement compromise. Further detailed design and cost study is suggested. Author (ESA)

N77-10086# European Space Agency, Paris (France).
EVALUATION OF FORCE MEASUREMENTS OF FREE FLYING MODELS IN A GUN TUNNEL
Wolfang Wyborny Sep. 1976 42 p refs Transl. into ENGLISH of "Die Auswertung von Kraftmessung an freifliegenden Modellen im Gun Tunnel", DFVLR, Cologne Report DLR-FB-76-10, 22 Jan. 1976 Original German report available from DFVLR, Cologne DM 18.50
(ESA-TT-314; DLR-FB-76-10) Avail: NTIS HC A03/MF A01

A free flight testing system that permits six component measurements without the influence of a sting and without interferences between the aerodynamic forces and moments is described briefly. The mathematical basis for the evaluation of the tests is described in detail. The AGARD calibration model HB-2 is used as an example to demonstrate the validity of the new technique. Author (ESA)

N77-10087# Arkansas Univ., Fayetteville. Dept. of Mechanical Engineering.
THE DESIGN AND CONSTRUCTION OF A CIRCULAR WEAR TRACK Final Report
Jack E. Helms, Jr., James G. Gleason, Steve Green, and Jack H. Cole Aug. 1975 57 p refs Prepared in cooperation with Arkansas State Highway Dept., Little Rock
(PB-252417/1) Avail: NTIS HC A04/MF A01 CSCL 14B

A test apparatus is described for determining the wear resistance of pavement surface materials. The apparatus employs a high torque, low speed, hydraulic vane motor as a direct rotating drive for the axle wheel assemblies. Tire path radius change is provided by reciprocating vertical hydraulic cylinder connected to a rack and pinion mechanism. The rate of path radius change relative to tire speed is controlled by an adjustable flow divider. A variable displacement axial piston pump, driven by an electric motor permits infinite adjustment of the rotational speed. The mean tire path diameter is fifteen feet, with a radius change capability of six inches. GRA

N77-10088# ARO, Inc., Arnold Air Force Station, Tenn.
STING DYNAMICS OF WIND TUNNEL MODELS Final Report, 1 Jul. 1974 - 30 Jun. 1975
James B. Billingsley AEDC May 1976 65 p refs
(ARO Proj. V37A-32A)
(AD-A024445; ARO-VKF-TR-75-150; AEDC-TR-76-41) Avail: NTIS HC A04/MF A01 CSCL 14/2

Wind tunnel model support stings can be subjected to transient aerodynamic and inertial loads which will create oscillatory translations and angular deflections. These transient oscillations always impair steady-state data accuracy and can be large enough to cause structural failure. The primary result of this investigation has been the formulation of a mathematical analysis for the dynamic response of sting-balance combinations subjected to arbitrary transient load inputs. The analysis also provides for sting rigid body motion so that model to tunnel injection and continuous sting rotation can be simulated. A computer program was written to numerically solve the sting-model-balance notion equations. GRA

N77-10089# IBM Federal Systems Div., Owego, N.Y.
PROGRAM DOCUMENTATION FOR THE DAIS TRIPLE TASK EXPERIMENT PROGRAM
W. E. Brandt, Jr. Wright-Patterson AFB, Ohio AMRL Dec. 1975 89 p
(Contract F33615-75-C-5152; AF Proj. 7184)
(AD-A024101; AMRL-TR-75-24; AMRL-HESS-75-4) Avail: NTIS HC A05/MF A01 CSCL 09/2

The DAIS Triple Task Experiment Program is a real-time, interactive, graphics system containing processing functions for simultaneously executing three separate experimental tasks. The primary task is a flight control task in which a subject 'flies' a simulated aircraft using digital and graphic display indicators to represent the aerodynamic parameters of the aircraft. A second

task involves a multifunction keyboard on which the subject is instructed to perform specific switching selections related to the communications and IFF systems onboard the simulated aircraft. And the third task is an information processing task designed to assess cognitive reserve capacity under various primary task loading conditions. The program was written for an IBM System/370, Model 155 computer operating under the standard MFT version of the Operating System. Both assembler language and FORTRAN were used in coding the subroutines, and the IBM 2250 Graphics Programming Services were utilized for the graphic software support. Author (GRA)

N77-10090# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
THE DESIGN, ANALYSIS AND TESTING OF A LOW BUDGET WIND TUNNEL FLUTTER MODEL WITH ACTIVE AERODYNAMIC CONTROLS, VOLUME 2 Final Report, 1 Dec. 1970 - 30 Nov. 1975
Randall M. Bolding and Ronald O. Stearman Jan. 1976 34 p refs Presented at the NASA Symp. on Flutter Testing, Edwards, Calif., 9-10 Oct. 1975
(Grant AF-AFOSR-1998-71; AF Proj. 9782)
(AD-A024480; AFOSR-76-0537TR-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 20/4

This report describes a low budget flutter model incorporating active aerodynamic controls for flutter suppression studies, concentrating on the interfering lifting surface flutter phenomenon in the form of a swept wing-tail configuration. A flutter suppression mechanism was first demonstrated on a simple semi-rigid three degree of freedom flutter model of this configuration employing an active stabilator control. These preliminary studies were extended to the analysis of a larger degree of freedom AFFDL wing-tail flutter model. The analytical and experimental design of a flutter suppression system for the AFFDL model is presented along with the results of a preliminary passive flutter test. Author (GRA)

N77-10368*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE CRYOGENIC WIND TUNNEL
Robert A. Kilgore *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1565-1581 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 14B

N77-10369*# George Washington Univ., Washington, D.C. Joint Inst. for Advancement of Flight Sciences.
DESIGN CONSIDERATIONS OF THE NATIONAL TRANSONIC FACILITY
Donald D. Baals *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1583-1602 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N77-10091*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE DEEP SPACE NETWORK Progress Report, Jul. - Aug. 1976
15 Oct. 1976 202 p refs
(Contract NAS7-100)
(NASA-CR-149101; JPL-PR-42-35) Avail: NTIS HC A10/MF A01 CSCL 22D

Network engineering, hardware and software development, and tracking station operations for support of deep space unmanned flight projects are summarized. For individual titles, see N77-10092 through N77-10110.

N77-10092*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NETWORK FUNCTIONS AND FACILITIES c14
N. A. Renzetti *In its* The Deep Space Network 15 Oct. 1976 p 1-3 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 14B

The objectives, functions, and organization of the Deep Space Network are summarized. Deep space station, ground communication, and network operations control capabilities are described. Author

N77-10093*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSN MARINER JUPITER-SATURN 1977 PROTOTYPE RADIO FREQUENCY SUBSYSTEM COMPATIBILITY STATUS AND TEST REPORT c17
A. I. Bryan and B. D. Madsen *In its* The Deep Space Network 15 Oct. 1976 p 4-10 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

An assessment was made of telecommunications capability between the radio frequency subsystem on the Mariner Jupiter-Spacecraft and the Deep Space Network. Author

N77-10094*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VIKING MISSION SUPPORT c17
R. J. Amorose and D. W. Johnston *In its* The Deep Space Network 15 Oct. 1976 p 11-19 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

Deep Space Network support is summarized for the two Viking missions to Mars and the Mars orbit insertions of Vikings 1 and 2 and the landing of Viking 1. Special procedures were employed during these critical events to minimize interruptions to the telemetry data return due to spacecraft data mode and attitude changes. Author

N77-10095*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PIONEER MISSION SUPPORT c17
T. P. Adamski *In its* The Deep Space Network 15 Oct. 1976 p 20-23 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

Status of the current Pioneer missions and initial operations planning for the Pioneer Venus mission is given. Author

N77-10096*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HELIOS MISSION SUPPORT c17
P. S. Goodwin, W. G. Meeks, and R. E. Morris *In its* The Deep Space Network 15 Oct. 1976 p 24-27 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

Deep Space Network support of the Helios mission is reported. Downlink signal degradation on the Helios-1 spacecraft and occultation of Helios-2 are discussed. Capability and performance of the network are assessed. A.H.

N77-10097*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HARDWARE ADDITIONS TO MICROPROCESSOR ARCHITECTURE AID SOFTWARE DEVELOPMENT c61
M. W. Sievers *In its* The Deep Space Network 15 Oct. 1976 p 28-33 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 09B

An address trap (breakpoint) mechanism and last-in-first-out (LIFO) address stack are suggested as two additions to the basic microprocessor architecture whose functions are solely to aid the programmer. These devices provide the programmer with the ability to specify address breakpoints and to trace program execution back through N instructions, where N is the depth of the stack. Both devices, plus interface logic and buffering, have been designed for an INTEL 8080-based system using approximately 25 integrated-circuit packages. Author

N77-10098*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE 512-CHANNEL CORRELATOR CONTROLLER c60
S. S. Brokl *In its* The Deep Space Network 15 Oct. 1976 p 34-41 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 09B

A high-speed correlator for radio and radar observations was developed and a controller was designed so that the correlator could run automatically without computer intervention. The correlator controller assumes the role of bus master and keeps track of data and properly interrupts the computer at the end of the observation. Author

N77-10099*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMAND DETECTOR SNR ESTIMATOR AND LOCK

STATUS MONITOR CIRCUITRY **c32**
R. F. Emerson *In its* The Deep Space Network 15 Oct. 1976 p 42-51 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

A breadboard of the command detector signal-to-noise-ratio estimator and lock status monitor was built on a wire-wrap card. The breadboard was integrated with the standard command detector, and its performance was measured. The design, design constraints, and construction of the breadboard are described. The performance is shown to agree with the theoretical model. Author

N77-10100*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THREE-LEVEL SAMPLER HAVING AUTOMATED THRESHOLDS **c65**
R. F. Jurgens *In its* The Deep Space Network 15 Oct. 1976 p 52-57 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 12A

A three-level sampler is described that has its thresholds controlled automatically so as to track changes in the statistics of the random process being sampled. In particular, the mean value is removed and the ratio of the standard deviation of the random process to the threshold is maintained constant. The system is configured in such a manner that slow drifts in the level comparators and digital-to-analog converters are also removed. The ratio of the standard deviation to threshold level may be chosen within the constraints of the ratios of two integers N and M. These may be chosen to minimize the quantizing noise of the sampled process. Author

N77-10101*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN ALGEBRAIC APPROACH TO IMAGE DE-SMEARING: SYMMETRIES OF POLYNOMIALS AND THEIR ZEROS **c64**
D. L. Johnson *In its* The Deep Space Network 15 Oct. 1976 p 58-63 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 12A

Frequently a photograph received from a spacecraft will be smeared by some process, e.g., by camera motion. Algebraically such smearing can be represented as p = sigma f, where sigma is the true picture, p is the received picture, and f is the smearing function. (p. sigma, and f are polynomials in two variables x and y.) Thus, in principle, sigma can be recovered by multiplying p by 1/f. However, there are problems involved in computing 1/f. Some of these problems are investigated. Author

N77-10102*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE FAST DECODING OF REED-SOLOMON CODES USING NUMBER THEORETIC TRANSFORMS **c64**
I. S. Reed (Univ. of Southern Calif.), L. R. Welch (Univ. of Southern Calif.), and T. K. Truong *In its* The Deep Space Network 15 Oct. 1976 p 64-77 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 12A

It is shown that Reed-Solomon (RS) codes can be encoded and decoded by using a fast Fourier transform (FFT) algorithm over finite fields. The arithmetic utilized to perform these transforms requires only integer additions, circular shifts and a minimum number of integer multiplications. The computing time of this transform encoder-decoder for RS codes is less than the time of the standard method for RS codes. More generally, the field GF(q) is also considered, where q is a prime of the form K x 2 to the nth power + 1 and K and n are integers. GF(q) can be used to decode very long RS codes by an efficient FFT algorithm with an improvement in the number of symbols. It is shown that a radix-8 FFT algorithm over GF(q squared) can be utilized to encode and decode very long RS codes with a large number of symbols. For eight symbols in GF(q squared), this transform over GF(q squared) can be made simpler than any other known number theoretic transform with a similar capability. Of special interest is the decoding of a 16-tuple RS code with four errors. Author

N77-10103*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LS-44: AN IMPROVED DEEP SPACE NETWORK STATION LOCATION SET FOR VIKING NAVIGATION **c14**
H. M. Koble, G. E. Pease, and K. W. Yip *In its* The Deep Space Network 15 Oct. 1976 p 79-98 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 14B

Improved estimates for the spin axis and longitude components of the Deep Space Network station locations were obtained from post-flight processing of radio metric data received from various Mariner planetary missions. The use of an upgraded set of ionospheric calibrations and the incorporation of near-Venus and near-Mercury radio metric data from the Mariner 10 spacecraft are the principal contributing effects to the improvement. These new estimates, designated Location Set (LS) 44, have supported Viking navigation activities in the vicinity of Mars. As such, the station locations were determined relative to the planetary positions inherent in JPL Development Ephemeris (DE) 84, which was used throughout the Viking mission. The article also presents and discusses a version of LS 44 based upon the latest planetary ephemeris, DE 96. Author

N77-10104*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH-EFFICIENCY SOLAR CONCENTRATOR **c44**
F. L. Lansing and J. Dorman *In its* The Deep Space Network 15 Oct. 1976 p 99-109 ref (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 10A

A new type of solar concentrator is presented using liquid lenses and simple translational tracking mechanism. The concentrator achieves a 100:1 nominal concentration ratio and is compared in performance with a flat-plate collector having two sheets of glazing and non-selective coating. The results of the thermal analysis show that higher temperatures can be obtained with the concentrator than is possible with the non-concentrator flat-plate type. Furthermore, the thermal efficiency far exceeds that of the comparative flat-plate type for all operating conditions. Author

N77-10105*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A TWO-DIMENSIONAL FINITE DIFFERENCE SOLUTION FOR THE TRANSIENT THERMAL BEHAVIOR OF TUBULAR SOLAR COLLECTOR **c44**
F. L. Lansing *In its* The Deep Space Network 15 Oct. 1976 p 110-127 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 10A

A numerical procedure was established using the finite-difference technique in the determination of the time-varying temperature distribution of a tubular solar collector under changing solar radiancy and ambient temperature. Three types of spatial discretization processes were considered and compared for their accuracy of computations and for selection of the shortest computer time and cost. The stability criteria of this technique was analyzed in detail to give the critical time increment to ensure stable computations. The results of the numerical analysis were in good agreement with the analytical solution previously reported. The numerical method proved to be a powerful tool in the investigation of the collector sensitivity to two different flow patterns and several flow control mechanisms. Author

N77-10106*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADIO FREQUENCY BORESIGHT ANALYSIS OF THE LOW COST 64-METER ANTENNA **c32**
M. S. Katow *In its* The Deep Space Network 15 Oct. 1976 p 128-135 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

Configurations (two) of the reflector-only assemblies, using different width backup cones, are analyzed for RF boresight direction changes and wind distortions. The wider backup cone is best for minimum weight; however, there is an optimum weight which minimizes the RF boresight errors for a wind load that produces the maximum pitching moment of both configurations. Author

N77-10107*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE PIONEER 11 1976 SOLAR CONJUNCTION: A UNIQUE OPPORTUNITY TO EXPLORE THE HELIOGRAPHIC LATITUDINAL VARIATIONS OF THE SOLAR CORONA **c13**
A. L. Berman, J. A. Wackley, S. T. Rockwell, and J. G. Yee *In its* the Deep Space Network 15 Oct. 1976 p 136-147 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 22A

The 1976 Pioneer II Solar Conjunction provided the opportun-

ity to accumulate a substantial quantity of doppler noise data over a dynamic range of signal closest approach point heliographic latitudes. The observed doppler noise data were fit to the doppler noise model ISED, and the deviations of the observed doppler noise data from the model were used to construct a (multiplicative) function to describe the effect of heliographic latitude. This expression was then incorporated into the ISED model to produce a new doppler noise model-ISEDB. Author

N77-10108*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VIKING 1 PLANETARY PHASE TRACKING OPERATIONS: MARS ORBIT INSERTION THROUGH LANDING c17
A. L. Berman and J. A. Wackley *In its* The Deep Space Network 15 Oct. 1976 p 148-170 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

This article describes tracking operations during the Viking 1 planetary phase. Particular attention is paid to special planning for critical phase tracking operations, and to the degree of success subsequently achieved by these special plans during the actual operations. In-depth coverage is provided for Mars orbit insertion (MOI), periapsis passage tracking, and Lander direct links. The article concludes that on balance, tracking operations during the Viking 1 planetary phase have been effectively implemented and quite successful. Author

N77-10109*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN APPROACH TO IMPROVE MANAGEMENT VISIBILITY WITHIN THE PROCUREMENT AND FINANCIAL GROUP AT GOLDSTONE c81
F. R. Maiocco and J. B. Rozek *In its* The Deep Space Network 15 Oct. 1976 p 171-179 ref (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 05A

Improvements in the operational efficiency of the data management systems at the Goldstone Deep Space Communications Complex (GDSCC) are discussed. This addresses the existing procurement and financial management data system at GDSCC, identifies management requirements for better visibility, descrives a proposed computerized data management system, summarizes results to data, and identifies plans for future development. Author

N77-10110*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A TECHNIQUE FOR GENERATING CORRELATED X-BAND WEATHER DEGRADATION STATISTICS c17
E. C. Posner and F. J. Zeigler *In its* The Deep Space Network 15 Oct. 1976 p 180-196 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

It is, known that the X-band noise temperature of DSN receivers can go up from 20 K to over 100 K or more, if the air is heavily laden with water vapor, although that is an uncommon occurrence. It is proposed that the DSN furnish flight projects relying on X-band degradation models, one for each DSN Complex. Such models would be in the form of a random process generator, say in an MBASIC program, that would permit the project to generate X-band degradation data with the right autocorrelations for periods of interest to the Projects. The autocorrelation modeling is especially important because bursts of degradation lasting several days can affect data storage and mission sequence design strategy. One approach which works if the degradation statistics obey a half-gaussian law. That is, the random variables are formed by taking the absolute values of another set of random variables, themselves having a Gaussian distribution. The technique then permits the half-gaussian random variables to have given one and two-step correlation coefficients. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N77-10107*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE PIONEER 11 1976 SOLAR CONJUNCTION: A UNIQUE OPPORTUNITY TO EXPLORE THE HELIOGRAPHIC LATITUDINAL VARIATIONS OF THE SOLAR CORONA
A. L. Berman, J. A. Wackley, S. T. Rockwell, and J. G. Yee *In its* the Deep Space Network 15 Oct. 1976 p 136-147 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 22A

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

N77-10111# European Space Research and Technology Center, Noordwijk (Netherlands).
TESTING MATERIALS FOR SPACE APPLICATIONS
J. Dauphin Paris ESA Sep. 1976 24 p refs
(ESA-TN-128-ESTEC) Avail: NTIS HC A02/MF A01

Different test methods set up by ESTEC Materials Section for the purpose of testing space materials are briefly described. The test philosophy is set forth. It is based on the use of the already existing standards and on new developments only in those areas where no suitable method exists, i.e., environmental tests (thermal vacuum, UV/particle irradiations, thermal cycling) and measurements (thermal/optical properties, contamination, adhesion). Author (ESA)

N77-10092*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NETWORK FUNCTIONS AND FACILITIES
N. A. Renzetti *In its* The Deep Space Network 15 Oct. 1976 p 1-3 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 14B

N77-10103*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LS-44: AN IMPROVED DEEP SPACE NETWORK STATION LOCATION SET FOR VIKING NAVIGATION
H. M. Koble, G. E. Pease, and K. W. Yip *In its* The Deep Space Network 15 Oct. 1976 p 79-98 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 14B

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N77-10112* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MULTIPLE IN-LINE DOCKING CAPABILITY FOR ROTATING SPACE STATIONS Patent
Leon B. Weaver and Claude D. Pegden, inventors (to NASA) Issued 10 Jul. 1973 8 p Filed 12 Apr. 1972 Supersedes N72-25853 (10 - 16, p 2213)
(NASA-Case-MFS-20855-1; US-Patent-3,744,739; US-Patent-Appl-SN-243374; US-Patent-Class-244-1SD) Avail: US Patent Office CSCL 22B

The invention comprises means for hard docking a number of space vehicles with a rotating space station, and includes an axially positioned dome on which are located two intermeshing docking turrets. Each turret carries multiple docking ports extending radially from the turret axis, along which axis final access to the space station is accomplished through the turret hub. The turrets intermesh and rotate about their hubs, by means of a power source and suitable ring gears and bevel pinions, to successively position one of the docking ports on the axis of rotation of the space station, while the remaining ports are positioned off center, and alternately rotated into such docking position to receive an additional space craft. The arrangement allows docking in-line with the axis of rotation of the station,

and multiple vehicles to be thus docked and then placed in holding position. Official Gazette of the U.S. Patent Office

N77-10113* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ATTITUDE CONTROL SYSTEM Patent
George L. vonPragenau and Charles C. Rupp, inventors (to NASA) Issued 5 Oct. 1976 5 p Filed 2 Oct. 1974 Supersedes N74-35096 (12 - 24, p 2977) Published under the second Trial Voluntary Protest Program as B 511,346, 27 Jan. 1976
(NASA-Case-MFS-22787-1; US-Patent-3,984,072; US-Patent-Appl-SN-511346; US-Patent-Class-244-169; US-Patent-Class-244-3.21; US-Patent-Class-244-171) Avail: US Patent Office CSCL 22B

An attitude control system is described in which angular rate signals are generated by rate gyros mounted closely adjacent to gimbaled engines at the rear of a vehicle. Error signals representative of a commanded change in vehicle angle or attitude are obtained from a precision inertial platform located in the nose region of the vehicle. The rate gyro derived signals dominate at high frequencies where dynamic effects become significant, and platform signals dominate at low frequencies where precision signals are required for a steady vehicle attitude. The blended signals are applied in a conventional manner to control the gimbaling of vehicle engines about control axes.
Official Gazette of the U.S. Patent Office

N77-10114*# Martin Marietta Corp., Denver, Colo.
ANALYSIS OF STRUCTURAL DYNAMIC DATA FROM SKYLAB. VOLUME 1: TECHNICAL DISCUSSION Final Report
Leonard Demchak and Harry Harcrow Aug. 1976 221 p refs (Contract NAS8-31224)
(NASA-CR-2727; M-175-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 22B

The results of a study to analyze data and document dynamic program highlights of the Skylab Program are presented. Included are structural model sources, illustration of the analytical models, utilization of models and the resultant derived data, data supplied to organization and subsequent utilization, and specifications of model cycles. Author

N77-10115*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DAILY SUMMARY FOR IMS HIGH-ALTITUDE SATELLITES, DAYS 1-181 1977
Oct. 1976 369 p
(NASA-TM-X-72600; NSSDC/WDC-A-R/S-76-07) Avail: NTIS HC A16/MF A01 CSCL 22C

A description of the orbital positions is provided for a number of high altitude satellites capable of making magnetospheric measurements in the first half of 1977 as part of the International Magnetospheric Study (IMS). Six artificial satellites -- Vela 5B, IMP-H, IMP-J, Solrad 11A, Solrad 11B, and Hawkeye 1 -- have been chosen along with the moon. The daily position summary of the satellites includes data tables which provide the crossing times of the bow shock and magnetopause, as well as the entry and exit times from the cusp, the high latitude tail, the midlatitude tail, and the neutral sheet region. Author

N77-10116*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY REPORT ON THE CTS TRANSIENT EVENT COUNTER PERFORMANCE THROUGH THE 1976 SPRING ECLIPSE SEASON
N. John Stevens, Robert R. Levell, and Vernon W. Klinect 1976 28 p refs Presented at Spacecraft Charging Conf., Colorado Springs, 27-29 Oct. 1976; sponsored by AF
(NASA-TM-X-73487; E-8879) Avail: NTIS HC A03/MF A01 CSCL 22B

The transient event counter (TEC), senses and counts transients having a voltage rise of greater than five volts in three separate wire harnesses: the attitude control harness, the solar array instrumentation harness and the solar array power harness. The operational characteristics of TEC are defined and the preliminary results obtained through the first 90 days of operation including the spring 1976 eclipse season are presented. The results show that the Communications Technology Satellite was charged to the point where discharges occurred. The discharge induced transients did not cause any anomalous events in spacecraft operation. The data indicate that discharges can occur at any time during the day without preference to any local time quadrant. The number of discharges occurring in the one second sample interval are greater than anticipated. The compilation and review of the data is continuing. Author

N77-10117*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CTS UNITED STATES EXPERIMENTS. A PROGRESS REPORT
W. H. Robbins and P. L. Donoughe 1976 16 p refs Presented at the 27th Intern. Astronautical Congr., Anaheim, Calif., 10-16 Oct. 1976; sponsored by Intern. Astronautical Federation
(NASA-TM-X-73510; E-8918) Avail: NTIS HC A02/MF A01 CSCL 22B

The results are presented of the United States experiments activity to date. Wide segments of the population are involved in the Experiments Program including the scientific community, other government agencies, industry, and the education and health entities. The experiments are associated with both technological objectives and the demonstration of new community and social services via satellite. Author

N77-10118*# Transemantics, Inc., Washington, D.C.
THE SALYUT-4 SPACE LABORATORY
K. P. Feoktistov NASA Oct. 1976 20 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (USSR), no. 4, Apr. 1976 p 17-24
(Contract NASw-2792)
(NASA-TT-F-17224) Avail: NTIS HC A02/MF A01 CSCL 22B

The basic technical characteristics of the Salyut-4 mission orbital station are reviewed. The medical equipment among the scientific and experimental equipment aboard the station is listed. The cosmonauts can adapt and work well in weightlessness.
Author

N77-10119*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PROVISIONAL SPECIFICATION FOR SATELLITE TIME IN A GEOMAGNETIC SUBSTORM ENVIRONMENT
N. John Stevens, Robert R. Lovell, and Carolyn K. Purvis 1976 14 p refs Presented at joint Air Force-NASA Spacecraft Charging Conf., Colorado Springs, Colo., 27-29 Oct. 1976
(NASA-TM-X-73446) Avail: NTIS HC A02/MF A01 CSCL 22A

Satellites in geosynchronous orbit have been experiencing operational anomalies. These anomalies are believed to be due to the environment charging the spacecraft surfaces to a point where discharges occur. In designing future satellites for long term operation at geosynchronous altitude, it is important that designers have a specification that will give the total time per year, the particle flux density, and particle energies that their satellites can be expected to encounter in these substorm environmental conditions. The limited data currently available on the environmental conditions was used to generate the provisional specification given. Author

N77-10120# Comision Nacional del Espacio Exterior, Mexico City (Mexico). Departamento de Cohetes Sonda.
PROJECT TLALOC [PROYECTO TLALOC]
Cesar T. Trevino Oct. 1976 35 p In SPANISH
Avail: NTIS HC A03/MF A01

A progress report on space investigation in Mexico is presented. Described are the TLALOC sounding rocket prototype and its objectives to study the composition, movements, and temperature of the atmosphere with special interests in concentration of clouds and creation of artificial rain by dispersion of chemical compounds. Author

N77-10121# Sandia Labs., Albuquerque, N.Mex.
AEROBALLISTIC AND MECHANICAL DESIGN AND DEVELOPMENT OF THE TALOS-TERRIER-RECRUIT (TATER) ROCKET SYSTEM WITH FLIGHT TEST RESULTS
L. R. Rollstin and R. D. Fellerhoff Feb. 1976 120 p refs

(Contract AT(29-1)-789)
(SAND-74-0440) Avail: NTIS HC A06/MF A01

The aerodynamic and mechanical design aspects and the performance analysis for the TATER rocket system are discussed. The TATER is a three stage, solid propellant rocket system capable of boosting a 70 lb recoverable payload to velocities of 10,500 to 11,000 ft/s in approximately 12 seconds from launch with a maximum velocity altitude variation of 10,000-30,000 ft on an ascent trajectory. ERA

N77-10122# Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany). Abteilung Vorprojekte und Studien.
SPACE SLED, PHASE A. COST REPORT
P. Natenbruk and P. Junk Jun. 1976 95 p
(Contract ESA-SC/89-HQ)
(PRV-8/76; ESA-CR(P)-802) Avail: NTIS HC A05/MF A01

Detailed cost estimates, based on a low cost approach, are established for the development and manufacture of Space Sled, in order to demonstrate the costwise feasibility of the project within a low-ceiling budget. Initial cost estimations are made transparent, prime cost impacts are identified, and subsequently cost estimates are subjected to a reduction process. It is shown that the major cost element is manpower; parts and material contribute much less to the total cost, thus offering less potential for savings. Hence emphasis must be retained on keeping a low manpower profile, avoiding any non-essential tasks, limiting project statussing and reporting, avoiding engineering changes as well as accepting reliability risks. Author (ESA)

N77-10123# European Space Research and Technology Center, Noordwijk (Netherlands).
COMPARATIVE ANALYSIS OF INTELSAT 4 AND ECS REPLENISHMENT POLICIES
G. P. Cantarella Paris ESA Sep. 1976 19 p refs
(ESA-TN-126-ESTEC) Avail: NTIS HC A02/MF A01

A comparative analysis is presented of the Intelsat 4 system (Atlantic Ocean) and the European Communications Satellite (ECS) system, the performance parameter under investigation being the probability of meeting specified traffic requirements at any given time during the mission life. An analysis was performed of the ECS system to show the improvements that can be achieved (in terms of probability of meeting specified traffic requirements during the mission life) by increasing the satellite lifetime from 7 to 10 years. Author (ESA)

N77-10124# European Space Research and Technology Center, Noordwijk (Netherlands).
ATMOSPHERIC ATTENUATION AND NOISE IN SATELLITE SYSTEMS AT 11/14 GHz
S. E. Dinwiddy Paris ESA Aug. 1976 13 p
(ESA-TM-167-ESTEC) Avail: NTIS HC A02/MF A01

Design values of earth-to-space atmospheric attenuation at 11 GHz and 14 GHz for the European region are presented which are based on the results of an extensive program of measurements using radiometers and which are being used as parameters for design of the European Communications Satellite System. Formulas for noise temperature in receivers in the satellite and in the earth stations are also presented to give a unified basis for system design. Author (ESA)

N77-10125# European Space Research and Technology Center, Noordwijk (Netherlands).
SOUNDING-ROCKET PAYLOADS C 111/1 AND C 111/2 LAUNCHED FROM ESRANGE ON 20 FEB. 1974
T. R. Sanderson and J. Henrion Paris ESA Dec. 1975 13 p
(ESA-TN-132-ESTEC) Avail: NTIS HC A02/MF A01

The sounding rocket payloads and the experiments and payload configuration are described. The events leading up to their launch are followed. The experiments consist of electric field probes, cold cathode pressure gages, a particle experiment, and an oblique resonance plasma probe. Launch took place into different phases of the same auroral substorm. Author (ESA)

N77-10126# ARO, Inc., Arnold Air Force Station, Tenn.
A WIND TUNNEL INVESTIGATION OF IMPULSE EFFECTS ON THE MOTION OF AN IMPULSE CORRECTION GUIDANCE MISSILE Final Report
Bob L. Uselton AEDC Apr. 1976 46 p refs
(AF Proj. 2547)
(AD-A024210; ARO-VKF-TR-75-155; AEDC-TR-76-6; AFATL-TR-75-164) Avail: NTIS HC A03/MF A01 CSCL 16/4

Wind tunnel tests were conducted for the Air Force Armament Laboratory to obtain experimental data at Mach number 3 on an impulse correction guidance system. The guidance system is based on the principle of impulse correction. The purpose of the test program was to determine if the interaction of the impulse explosion with the supersonic airflow caused an effect on the model motion. The small-amplitude free-oscillation technique was used to obtain data on a 0.5 scale model at angles of attack from 1 to 4.4 deg at Reynolds numbers, based on model length, of 12.2 x 100,000 and 23.1 x 100,000. The explosion which produced the impulse affected the model flow field. However, this perturbed flow field did not produce any significant effects on the model motion, apparently because of the short action time involved. Author (GRA)

N77-10127# Prototype Development Associates, Inc., Santa Ana, Calif.
LOW COST FLIGHT TEST CAPABILITIES STUDY Final Report, 13 Jun. - 13 Dec. 1975
John P. Crenshaw 19 Jan. 1976 201 p refs
(Contract N60921-75-C-0230; SF32322507)
(AD-A024421; PDA-TR-5006-00-01) Avail: NTIS HC A10/MF A01 CSCL 16/4

The feasibility of obtaining low cost flight data relevant to Intercontinental Ballistic Missile (ICBM) reentry problems has been investigated. Multiple subscale payloads launched from booster systems composed primarily of surplus Minuteman I or Spartan hardware are shown to satisfy that objective. Computed simulations of ICBM flight conditions achievable through subscale testing are presented for a wide range of subscale reentry vehicle conditions and potential flight test objectives. An example of a low cost flight test program is presented in terms of booster systems, compatible ranges, flight test vehicle designs, experiment definitions, and program costs. GRA

N77-10128# Naval Research Lab., Washington, D.C.
AN ANALYSIS OF THE BREAKUP OF SATELLITE 1974-103A (COSMOS 699) Interim Report
William B. Heard 23 Apr. 1976 21 p refs
(NRL Proj. 301-10; RR0030241)
(AD-A024450; NRL-7991) Avail: NTIS HC A02/MF A01 CSCL 15/3

The theory of satellite breakup based on statistical mechanics is extended in the area of the inverse problem and is applied to the 17 April 1975 breakup of Cosmos 699. The breakup is shown to be highly nonisotropic. In addition to the main event, there is evidence for smaller breakups separated from it by intervals of -2, -1, and -3 revolutions. Author (GRA)

N77-10129# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
FORCED DYNAMICS OF ASYMMETRIC SPACECRAFT
Jeffrey N. Blanton and John L. Junkins Jan. 1976 61 p refs
(Contract DAAK02-75-C-0072)
(AD-A024134; RLES-ESS-3323-102-76; ETL-0039) Avail: NTIS HC A04/MF A01 CSCL 22/3

The purpose of this research was the development of new techniques for the determination and simulation of satellite attitude dynamics. Several distinct non-torque-free/non-rigid body applications are considered. GRA

N77-10130# Physics International Co., San Leandro, Calif.
HYPERVELOCITY LAUNCHER DESIGN Final Report, 1 Apr. 1974 - 1 Sep. 1975
K. Seifert May 1976 169 p refs
(Contract DNA001-74-C-0265; DNA Proj. NWED-QAXAA129)
(AD-A024568; PIFR-708; DNA-3869F) Avail: NTIS HC A08/MF A01 CSCL 19/6

This report describes the results of an experimental program conducted by Physics International to develop a high-performance light-gas to launch projectiles. With this launcher the flight dynamics of re-entry vehicles could be studied to obtain erosion and ablation data in a cost-effective laboratory environment. Author (GRA)

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N77-10131*# Aeronutronic Ford Corp., Houston, Tex. Space Information Systems Operation.
MCC/SHUTTLE TEST PLAN. VOLUME 1: PHILOSOPHY AND GUIDELINES
21 Sep. 1976 38 p
(Contract NAS9-15014)
(NASA-CR-151085; JSC-10309-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 22B

The Mission Control Center/Shuttle Test Plan is defined from development through operations to a level of detail which will support the National Aeronautics and Space Administration and contractor management in the following areas: test management, test tool development, and resource and schedule planning.
Author

N77-10132*# Chrysler Corp., New Orleans, La. Space Div.
RESULTS OF WIND TUNNEL RCS INTERACTION TESTS ON A 0.010-SCALE SPACE SHUTTLE ORBITER MODEL (51-0) IN THE CALSPAN CORPORATION 48-INCH HYPERSONIC SHOCK TUNNEL (TEST 0A93)
J. J. Daileda (Rockwell Intern. Corp., Downey Calif.), J. Marroquin (Rockwell Intern. Corp., Downey, Calif.), and C. E. Rogers (Calspan Corp.) Oct. 1976 115 p refs Prepared jointly with Rockwell Intern. Corp., Downey, Calif. and Calspan Corp., Buffalo, N. Y.
(Contract NAS9-13247)
(NASA-CR-141847; DMS-DR-2238) Avail: NTIS HC A06/MF A01 CSCL 01A

A hypersonic shock tunnel test on a 0.010 scale SSV orbital configuration was performed to determine the effects of RCS jet/flow field interactions on SSV aerodynamic stability and control characteristics at various hypersonic Mach and Reynolds numbers. Flow field interaction data were obtained using pitch and roll jets. In addition, direct impingement data were obtained at a Mach number of zero with the test section pumped down to below 10 microns of mercury pressure. Author

N77-10133*# Chrysler Corp., New Orleans, La. Space Div.
RESULTS OF THE LOW SPEED AEROELASTIC BUFFET TEST WITH A 0.046-SCALE MODEL (747-AX1322-D-3/ORBITER 8-0) OF THE 747 CAM/ORBITER IN THE UNIVERSITY OF WASHINGTON WIND TUNNEL (CS 3)
R. L. Gillins (Rockwell Intern. Corp., Downey, Calif.) Oct. 1976 77 p refs Prepared jointly with Rockwell Intern. Corp., Downey, Calif.
(Contract NAS9-13247)
(NASA-CR-147639; DMS-DR-2338) Avail: NTIS HC A05/MF A01 CSCL 02A

A series of wind tunnel studies designed to assess the potential buffet problems resulting from orbiter wake characteristics with its tailcone removed are presented to provide design loads and acceleration environments, and to develop data on buffet sensitivity to various aerodynamic configurations and flight parameters. Data are intended to support subsequent analyses of structural fatigue life, crew efficiency, and equipment vibrations. Author

N77-10134*# Chrysler Corp., New Orleans, La. Space Div.
FLOW VISUALIZATION TESTS OF A 0.004-SCALE SPACE SHUTTLE VEHICLE 2A MODEL (NO. 13-OTS) IN THE MSFC 14-INCH TRISONIC WIND TUNNEL (IS6A)
P. J. Hawthorne (Rockwell Intern., Downey, Calif.) and Gary Streby (Northrop Services, Inc., Huntsville, Ala.) Oct. 1976 37 p refs
(Contract NAS9-13247)
(NASA-CR-147640; DMS-DR-2158) Avail: NTIS HC A03/MF A01 CSCL 02A

Documented are representative photographs of surface flow patterns, created by oil flow and shadowgraph techniques, obtained during wind tunnel tests of an 0.004-scale version of the 2A SSV orbiter. The purpose of this test series was to obtain flow visualization photographs to aid in interpretation of test IS1 aero-noise data. The test was conducted at nominal Mach numbers from 0.6 to 3.48. The orbiter was run in proximity to the external tank and solid rocket boosters at angles of attack from -5 deg to +9 deg at 0 deg angle of sideslip.
Author

N77-10135*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
ON-ORBIT FLIGHT CONTROL ALGORITHM DESCRIPTION
May 1975 254 p refs
(Contract NAS9-13809)
(NASA-CR-151088; R-881) Avail: NTIS HC A12/MF A01 CSCL 22A

Algorithms are presented for rotational and translational control of the space shuttle orbiter in the orbital mission phases, which are external tank separation, orbit insertion, on-orbit and de-orbit. The program provides a versatile control system structure while maintaining uniform communications with other programs, sensors, and control effectors by using an executive routine/functional subroutine format. Software functional requirements are described using block diagrams where feasible, and input--output tables, and the software implementation of each function is presented in equations and structured flow charts. Included are a glossary of all symbols used to define the requirements, and an appendix of supportive material. Author

N77-10136*# Chrysler Corp., New Orleans, La. Space Div.
RESULTS FROM A CONVECTIVE HEAT TRANSFER RATE DISTRIBUTION TEST ON A 0.0175 SCALE MODEL (22-0) OF THE ROCKWELL INTERNATIONAL VEHICLE 4 SPACE SHUTTLE CONFIGURATION IN THE AEDC-VKF TUNNEL B (OH49B), VOLUME 1 Aerothermodynamic Data Report
B. J. Herrera (Rockwell Intern. Corp., Downey, Calif.) Oct. 1976 860 p refs 2 Vol.
(Contract NAS9-13247)
(NASA-CR-147626; DMS-DR-2222-Vol-1) Avail: NTIS HC A99/MF A01 CSCL 20D

The tests were conducted in a hypersonic wind tunnel at Mach number 8 to investigate reentry mode convective heat--transfer rates to the vehicle 4 shuttle orbiter. The thin skin thermocouple technique was used to obtain the heat transfer rate measurements. A complete set of tabulated data is presented. Author

N77-10137*# Chrysler Corp., New Orleans, La. Space Div.
RESULTS FROM A CONVECTIVE HEAT TRANSFER RATE DISTRIBUTION TEST ON A 0.0175 SCALE MODEL (22-0) OF THE ROCKWELL INTERNATIONAL VEHICLE 4 SPACE SHUTTLE CONFIGURATION IN THE AEDC-VKF TUNNEL B(OH49B), VOLUME 2 Aerothermodynamic Data Report
B. J. Herrera (Rockwell Intern. Corp, Downey, Calif.) Oct. 1976 688 p refs 2 Vol.
(Contract NAS9-13247)
(NASA-CR-147627; DMS-DR-2222-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 20D

For abstract, see preceding accession.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

N77-10138*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CONICAL-SCAN TRACKING WITH THE 64-m-DIAMETER ANTENNA AT GOLDSTONE
J. E. Ohlson and M. S. Reid (Naval Postgraduate School) 1 Oct. 1976 38 p refs
(Contract NAS7-100)

(NASA-CR-149144; JPL-TR-32-1605) Avail: NTIS HC A03/MF A01 CSCL 17I

The theory and experimental work which demonstrated the feasibility of conical-scan tracking with a 64 m diameter paraboloid antenna is documented. The purpose of this scheme is to actively track spacecraft and radio sources continuously with an accuracy superior to that obtained by manual correction of the computer driven pointing. The conical-scan implementation gives increased tracking accuracy with X-band spacecraft signals, as demonstrated in the Mariner Venus/Mercury 1973 mission. Also, the high accuracy and ease of measurement with conical-scan tracking allow evaluation of systematic and random antenna tracking errors. Author

N77-10093*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSN MARINER JUPITER-SATURN 1977 PROTOTYPE RADIO FREQUENCY SUBSYSTEM COMPATIBILITY STATUS AND TEST REPORT
A. I. Bryan and B. D. Madsen *In its* The Deep Space Network 15 Oct. 1976 p 4-10 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

N77-10094*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VIKING MISSION SUPPORT
R. J. Amorose and D. W. Johnston *In its* The Deep Space Network 15 Oct. 1976 p 11-19 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

N77-10095*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PIONEER MISSION SUPPORT
T. P. Adamski *In its* The Deep Space Network 15 Oct. 1976 p 20-23 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

N77-10096*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HELIOS MISSION SUPPORT
P. S. Goodwin, W. G. Meeks, and R. E. Morris *In its* The Deep Space Network 15 Oct. 1976 p 24-27 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

N77-10108*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VIKING 1 PLANETARY PHASE TRACKING OPERATIONS: MARS ORBIT INSERTION THROUGH LANDING
A. L. Berman and J. A. Wackley *In its* The Deep Space Network 15 Oct. 1976 p 148-170 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

N77-10110*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A TECHNIQUE FOR GENERATING CORRELATED X-BAND WEATHER DEGRADATION STATISTICS
E. C. Posner and F. J. Zeigler *In its* The Deep Space Network 15 Oct. 1976 p 180-196 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

N77-10139*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AIR-BEARING SPIN FACILITY FOR MEASURING ENERGY DISSIPATION
Robert L. Peterson Washington Oct. 1976 25 p
(NASA-TN-D-8346; G-7696) Avail: NTIS HC A02/MF A01 CSCL 14B

The air-breathing spin facility was developed to determine experimentally the effect of energy dissipation upon the motion of spinning spacecraft. The facility consists of an air-bearing spin table, a telemetry system, a command system, and a ground control station. The air-bearing spin table was designed to operate in a vacuum chamber. Tests were run on spacecraft components such as fuel tanks, nutation dampers, reaction wheels, and active nutation damper systems. Each of these items affected the attitude of a spinning spacecraft. An experimental approach to determine these effects was required because the dissipation of these components could not be adequately analyzed. The results of these experiments have been used, with excellent results, to predict spacecraft motion. Author

N77-10140*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEM DESIGN FOR A NUCLEAR ELECTRIC SPACECRAFT UTILIZING OUT-OF-CORE THERMIONIC CONVERSION
W. C. Estabrook, W. M. Phillips, and T. Hsieh 1 Sep. 1976 30 p refs
(Contract NAS7-100)
(NASA-CR-149094; JPL-TM-33-791) Avail: NTIS HC A03/MF A01 CSCL 22B

Basic guidelines are presented for a nuclear space power system which utilizes heat pipes to transport thermal power from a fast nuclear reactor to an out of core thermionic converter array. Design parameters are discussed for the nuclear reactor, heat pipes, thermionic converters, shields (neutron and gamma), waste heat rejection systems, and the electrical bus bar-cable system required to transport the high current/low voltage power to the processing equipment. Dimensions are compatible with shuttle payload bay constraints. Author

N77-10141*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENVIRONMENTAL CHARGING TESTS OF SPACECRAFT THERMAL CONTROL LOUVERS
F. D. Berkopec, N. J. Stevens, F. W. Schmidt, and R. A. Blech Sep. 1976 38 p refs
(NASA-TM-X-73517; E-8927) Avail: NTIS HC A03/MF A01 CSCL 22B

The environmental charging of spacecraft surfaces program consists, in part, of experimental evaluation of material response to the environmental charged particle flux. A flight type spacecraft thermal control louver assembly has been tested in an electron flux. The louver blade surface potential, the louver assembly currents, and the relatively high number of discharges observed in the electron environment are self-consistent results. The unexpected result of this testing was the flutter observed when the louvers were closed. The flutter is about 1 to 2 Hz in frequency and is probably electrostatically induced. Author

N77-10142# European Space Agency, Paris (France).
DYNAMICS AND CONTROL OF NON-RIGID SPACECRAFT
Jul. 1976 376 p refs Proc. of the Symp. held at Frascati, Italy, 24-26 May 1976
(ESA-SP-117) Avail: NTIS HC A17/MF A01

Topics are presented in the field of flexible spacecraft configurations. Dynamic models are reviewed for spinning and non-spinning satellites. The attitude stability of flexible satellites is discussed. Applications of modern control theory are described. The design of control systems for these configurations is outlined. Test and flight verifications are reported, and some special dynamic problems are dealt with. ESA

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N77-10143*# McDonnell-Douglas Technical Services Co., Inc., Houston, Tex. Astronautic Div.
ERROR ANALYSIS OF THE SHUTTLE ORBITAL MANEUVER-

ING SYSTEM P-V-T PROPELLANT GAGING MODULE. MISSION PLANNING, MISSION ANALYSIS, AND SOFTWARE FORMULATION
D. D. Duhon 15 May 1975 14 p refs
(Contract NAS9-13970)
(NASA-CR-150965; DN-1.4-2-10) Avail: NTIS HC A02/MF A01 CSCL 14B

An investigation of the shuttle orbital maneuvering system (OMS) pressure-volume-temperature (P-V-T) propellant gaging module has revealed that the gaging errors due to the combined effects of random instrumentation measurement errors, propellant loading uncertainties, and simplifying assumptions in the software are non-linear over the range of the usable propellant quantity gage (0-100%), with the largest error being at the zero point. When the OMS propellant tanks in the orbiter vehicle pods are filled to contain 100% of the maximum usable propellant, the gaging error at the zero point was determined to be 9.5% for the fuel and 9.5% for the oxidizer. When the OMS propellant tanks initially contain 50% of the maximum usable propellant, the largest gaging error is still 9.5% for the fuel and 9.5% for the oxidizer. Author

N77-10144*# General Electric Co., Philadelphia, Pa. Space Div.
ONBOARD EXPERIMENT DATA SUPPORT FACILITY Final Report
Sep. 1976 308 p refs
(Contract NAS9-14651)
(NASA-CR-151034) Avail: NTIS HC A14/MF A01 CSCL 14B

An onboard array structure has been devised for end to end processing of data from multiple spaceborne sensors. The array constitutes sets of programmable pipeline processors whose elements perform each assigned function in 0.25 microseconds. This space shuttle computer system can handle data rates from a few bits to over 100 megabits per second. A.H.

N77-10145# European Space Research and Technology Center, Noordwijk (Netherlands).
A DIGITAL SOLAR ASPECT SENSOR FOR SPINNING SPACECRAFT
B. Morgenstern and B. Soederholm Paris ESA Jun. 1976 42 p
(ESA-TN-134-ESTEC) Avail: NTIS HC A03/MF A01

A digital solar-aspect sensor for spinning spacecraft was developed and prequalified. The principles of operation and details of the optical, electronic, and mechanical design of the sensor are described. The specification against which it was designed and built is presented. Test results are briefly described and compared with the specified requirements. Author (ESA)

N77-10146# Appleton Lab., Slough (England).
PHASE A STUDY OF SPACELAB-BORNE ATMOSPHERIC PASSIVE EXPERIMENTS. VOLUME 1: EXECUTIVE SUMMARY Final Report
[1976] 100 p refs 5 Vol.
(Contract ESA-SC/97-HQ)
(ESA-CR(P)-836-Vol-1) Avail: NTIS HC A05/MF A01

A study concerning atmospheric passive experiments for installation onboard Spacelab is summarized. Scientific objectives and passive sounder instruments are reviewed. The accommodation of instruments and packages on Spacelab is discussed. Estimates are given of costs and development timescales for passive sounder packages on first Spacelab. ESA

N77-10147# Regis Coll., Weston, Mass.
DEVELOPMENT AND APPLICATION OF ELECTRICAL AND MECHANICAL PROTOTYPE INSTRUMENTS FOR SPACE ENVIRONMENT STUDIES Technical Report, 15 Feb. 1975 - 3 Jan. 1976
Mukhtar Ahmed, Peter B. Anderson, William J. Burke, and Madhoo Kanal 28 Feb. 1976 24 p refs
(Contract F19628-75-C-0081; AF Proj. 8617)
(AD-A023815; AFGL-TR-76-0038; SR-1) Avail: NTIS HC A02/MF A01 CSCL 22/2

The following pertinent studies are detailed by the four authors: Variations in the characteristics of the low energy thermal plasma of the plasmasphere, seasonal and day-night changes and their effect on ionospheric F region; ionospheric scintillation studies at high latitudes and equatorial regions. Need of development of suitable instrumentation as evidenced in STP Satellite Program, Aeolus Rockets, DMSP Satellite, Scatha. Author (GRA)

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N77-10148* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ION BEAM THRUSTER SHIELD Patent
John L. Power, inventor (to NASA) Issued 5 Oct. 1976 8 p Filed 12 Sep. 1975 Supersedes N75-32166 (13 - 23, p 2885)
(NASA-Case-LEW-12082-1; US-Patent-3,983,695; US-Patent-Appl-SN-612964; US-Patent-Class-60-202; US-Patent-Class-313-361; US-Patent-Class-313-231.4; US-Patent-Class-313-240; US-Patent-Class-315-111.3) Avail: US Patent Office CSCL 21C

An ion thruster beam shield is provided that comprises a cylindrical housing that extends downstream from the ion thruster and a plurality of annular vanes which are spaced along the length of the housing, and extend inwardly from the interior wall of the housing. The shield intercepts and stops all charge exchange and beam ions, neutral propellant, and sputter products formed due to the interaction of beam and shield emanating from the ion thruster outside of a fixed conical angle from the thruster axis. Further, the shield prevents the sputter products formed during the operation of the engine from escaping the interior volume of the shield.
Official Gazette of the U.S. Patent Office

N77-10149*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF SERT 2 THRUSTERS AND SPACECRAFT 1976
William R. Kerslake 1976 12 p refs Proposed for presentation at Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976; sponsored by AIAA
(NASA-TM-X-73501) Avail: NTIS HC A02/MF A01 CSCL 21C

The historical record of the SERT II ion thrusters and spacecraft performance for 6 1/2 years since the February 1970 launch is reviewed. The most recent ion thruster operation test shows no changes since 1974. Thruster 2 is fully operational with no performance degradation. Thruster 1 has a high voltage grid short, but continues to demonstrate cathode and discharge relight capability. Spacecraft orbit and dynamic analysis indicates a stable, sun-synchronous spacecraft orientation by 1979. An attitude adjustment maneuver was performed in August 1976 to achieve this orientation and provide sufficient continuous solar power for thruster operation in 1979. Author

N77-10150*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A 30-cm DIAMETER ARGON ION SOURCE
J. S. Sovey 1976 16 p refs Presented at 12th Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976; sponsored by AIAA
(NASA-TM-X-73509; E-8917) Avail: NTIS HC A02/MF A01 CSCL 21C

A 30 cm diameter argon ion source was evaluated. Ion source beam currents up to 4a were extracted with ion energies ranging from 0.2 to 1.5 KeV. An ion optics scaling relation was developed for predicting ion beam extraction capability as a function of total extraction voltage, gas type, and screen grid open area. Ignition and emission characteristics of several hollow cathode geometries were assessed for purposes of defining

discharge chamber and neutralizer cathodes. Also presented are ion beam profile characteristics which exhibit broad beam capability well suited for ion beam sputtering applications.
Author

N77-10151*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODULAR THRUST SUBSYSTEM APPROACHES TO SOLAR ELECTRIC PROPULSION MODULE DESIGN
James E. Cake, G. Richard Sharp, John C. Oglebay, Francis J. Shaker, and Ralph J. Zavesky 1976 25 p refs Presented at the 12th Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976; sponsored by AIAA
(NASA-TM-X-73502; E-8800) Avail: NTIS HC A02/MF A01 CSCL 21C

Three approaches are presented for packaging the elements of a 30 cm ion thruster subsystem into a modular thrust subsystem. The individual modules, when integrated into a conceptual solar electric propulsion module are applicable to a multimission set of interplanetary flights with the space shuttle interim upper stage as the launch vehicle. The emphasis is on the structural and thermal integration of the components into the modular thrust subsystems. Thermal control for the power processing units is either by direct radiation through louvers in combination with heat pipes or an all heat pipe system. The propellant storage and feed system and thruster gimbal system concepts are presented. The three approaches are compared on the basis of mass, cost, testing, interfaces, simplicity, reliability, and maintainability.
Author

N77-10152*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH DENSITY PROPELLANT FOR SINGLE STAGE TO ORBIT VEHICLES
J. J. Notardonato and Philip A. Masters 1976 15 p refs Proposed for presentation at the JANNAF Propulsion Meeting, Atlanta, 7-9 Dec. 1976
(NASA-TM-X-73503; E-8850) Avail: NTIS HC A02/MF A01 CSCL 22B

Mixed mode propulsion concepts are studied for advanced, single stage earth orbital transportation systems (SSTO) for use in the post-1990 time period. These propulsion concepts are based on the sequential and/or parallel use of high density impulse and high specific impulse propellants in a single stage to increase vehicle performance and reduce dry weight. Specifically, the mixed mode concept utilizes two propulsion systems with two different fuels (mode 1 and mode 2) with liquid oxygen as a common oxidizer. Mode 1 engines would burn a high bulk density fuel for lift-off and early ascent to minimize performance penalties associated with carrying fuel tankage to orbit. Mode 2 engines will complete orbital injection utilizing liquid hydrogen as the fuel.
Author

N77-10153*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF 30-CENTIMETER-DIAMETER MERCURY ION THRUSTER ISOLATOR DEVELOPMENT
M. A. Mantenieks 1976 12 p refs Presented at 12th Intern. Electric Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976; sponsored by AIAA
(NASA-TM-X-73514; E-8921) Avail: NTIS HC A02/MF A01 CSCL 21C

Results are presented of several 30 cm diameter mercury ion thruster isolator life tests that show that the onset and exponential increase of leakage current problems observed in earlier thruster operations and isolator tests have been solved. A 10,006 hour life test of a main isolator vaporizer operated with no mercury flow at 320 C and 1500 volts was found to have no onset of leakage current during the test. A cathode-isolator vaporizer operated with a mercury discharge at 340 to 360 C and 1200 volts for 18,000 hours, was found to have a small increase of leakage current with time. A 10,000 hour thruster life test exhibited no increase of leakage current during the life test. Isolators have been developed which will satisfy 30 cm mercury ion thruster mission requirements.
Author

N77-10154*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A THRUST-SHEET PROPULSION CONCEPT USING FISSIONABLE ELEMENTS
W. E. Moeckel 1976 13 p refs Presented at Intern. Electric Propulsion Conf., Key Biscayne, Fla., 14-17 Nov. 1976; sponsored by AIAA
(NASA-TM-X-73469) Avail: NTIS HC A02/MF A01 CSCL 21H

A space propulsion concept is proposed and analyzed which consists of a thin sheet coated on one side with fissionable material, so that nuclear power is converted directly into propulsive power. Thrust is available both from ejected fission fragments and from thermal radiation. Optimum thicknesses are determined for the active and substrate layers. This concept is shown to have potential mission capability (in terms of velocity increments) superior to that of all other advanced propulsion concepts for which performance estimates are available. A suitable spontaneously fissioning material such as Cf254 could provide an extremely high-performance first stage beyond earth orbit. In contrast with some other advanced nuclear propulsion concepts, there is no minimum size below which this concept is infeasible.
Author

N77-10155*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A 15,000-HOUR CYCLIC ENDURANCE TEST OF AN 8-CENTIMETER-DIAMETER ELECTRON BOMBARDMENT MERCURY ION THRUSTER
Shigeo Nakanishi 1976 37 p refs Presented at the 12th Intern. Elec. Propulsion Conf., Key Biscayne, Fla., 15-17 Nov. 1976; sponsored by AIAA
(NASA-TM-X-73508; E-886) Avail: NTIS HC A03/MF A01 CSCL 21C

A laboratory model 8 cm thruster with improvements to minimize ion chamber erosion and peeling of sputtered metal was subjected to a cyclic endurance test for 15,040 hours and 460 restarts. A charted history of several thruster operating variables and off-normal events are shown in 600-hour segments at three points in the test. The transient behavior of these variables during a typical start-stop cycle is presented. Finding of the post-test inspection confirmed most of the expected results. Charge exchange ions caused normal accelerator grid erosion. The workability of the various design features was substantiated, and attainable improvements in propellant utilization efficiency should significantly reduce accelerator erosion.
Author

N77-10156# European Space Agency, Paris (France).
AN ANALYTICAL MASS MODEL OF CHEMICAL ROCKET STAGES FOR SPACE FLIGHT MISSIONS. PART 2: LONG DURATION MISSIONS
Juergen Broschk, Maurice M. Bunn, Detlef Manski et al Sep. 1976 41 p refs Transl. into ENGLISH of "Ein anal. Massenmodell chem. Raketenstufen fuer Raumflugmissionen. Teil 2: Langzeitmissionen", DFVLR, Lampoldshausen, West Ger. Report DLR-FB-76-17, Jan. 1976 Original German report available from DFVLR, Cologne DM 21.70
(ESA-TT-310; DLR-FB-76-17) Avail: NTIS HC A03/MF A01

Approximating equations were derived to design optimal propellant insulation systems for transfer stages. Propellant, mission duration, thermal environment, insulating material, transfer stage design, and the orientation of the stage to the heat source were independent parameters for the computations. An optimized proportion of insulation mass and vaporized propellant mass was obtained. Maximum payload capacity was the optimizing criteria where the total mass and velocity requirement of the stage were given.
Author (ESA)

N77-10157# European Space Agency, Paris (France).
AN ANALYTICAL MASS MODEL OF CHEMICAL ROCKET STAGES FOR SPACE FLIGHT MISSIONS. PART 1: DESCRIPTION OF THE MODEL
Maurice M. Bunn, Juergen Broschk, Detlef Manski et al Sep. 1976 50 p refs Transl. into ENGLISH of "Ein anal. Massenmodell chem. Raketenstufen fuer Raumflugmissionen. Teil 1: Beschreibung des Modells", DFVLR, Lampoldshausen, West Ger. Report DLR-FB-76-16, 26 Feb. 1976 Original German report available from DFVLR, Cologne DM 21.70
(ESA-TT-316; DLR-FB-76-16) Avail: NTIS HC A03/MF A01

A method to size transfer stages for different chemical

propellants and system designs is presented. The influence of construction and performance parameters on system mass for different space missions was investigated systematically. Methods for computing and optimizing system masses of 15 selected stage designs are described, and a FORTRAN program is presented. Further comparison of such mass-optimized transfer stages is possible, based on additional criteria. Author (ESA)

N77-10158# European Space Research and Technology Center, Noordwijk (Netherlands).
PRESENTATION OF THE ESRO ACTIVITIES IN THE FIELD OF HYDRAZINE MONOPROPELLANT TECHNOLOGY FOR SATELLITE AUXILIARY PROPULSION
H. A. Pfeffer 8 Oct. 1974 9 p Presented at the Conf. on Hydrazine, Poitiers, France, Oct. 1974 Revised
Avail: NTIS HC A02/MF A01

A survey is presented of the past and present ESA hydrazine technology program for satellite auxiliary propulsion. The main activity described is catalyst development. Other activities include materials compatibility, hydrazine mixtures, and tanks. Future activities will build on technologies presently developed and should lead to a complete range of qualified components. ESA

N77-10242*# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
NONLINEAR EFFECTS IN THERMAL STRESS ANALYSIS OF A SOLID PROPELLANT ROCKET MOTOR
E. C. Francis, R. L. Peeters, and S. A. Murch *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 111-135 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10373*# Vanderbilt Univ., Nashville, Tenn.
THREE-DIMENSIONAL FINITE ELEMENT ANALYSIS OF ACOUSTIC INSTABILITY OF SOLID PROPELLANT ROCKET MOTORS
Robert M. Hackett and Radwan S. Juruf *In* NASA. Langley Res. Center Advan in Eng. Sci., Vol. 4 1976 p 1641-1651 refs (For primary document see N77-10345 01-31)
(Contract DAHC04-72-A-0001)
Avail: NTIS HC A22/MF A01

N77-10375*# Texas Univ., Austin.
FLOW FIELD FOR AN UNDEREXPANDED, SUPERSONIC NOZZLE EXHAUSTING INTO AN EXPANSIVE LAUNCH TUBE
Robert R. Morris, John J. Bertin, and James L. Batson, (Army Missile Command) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1665-1671 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

N77-10376*# Alabama Univ., Tuscaloosa.
EFFECTS OF PERIODIC UNSTEADINESS OF A ROCKET ENGINE PLUME ON THE PLUME-INDUCED SEPARATION SHOCK WAVE
Julian O. Doughty *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1673-1683 refs (For primary document see N77-10345 01-31)
(Contract NAS8-30624)
Avail: NTIS HC A22/MF A01

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N77-10159# California Univ., Livermore. Lawrence Livermore Lab.
PHASE DIAGRAMS OF THE ELEMENTS
D. A. Young 11 Sep. 1975 68 p refs
(Contract W-7405-eng-48)
(UCRL-51902) Avail: NTIS HC A04/MF A01

The pressure temperature phase diagrams of the elements are presented, with graphs of the experimentally determined solid-solid phase boundaries and melting curves. Comments, including theoretical discussion, are provided for each diagram. The crystal structure of each solid phase is identified and discussed. This work is aimed at encouraging further experimental and theoretical research on phase transitions in the elements.
Author (ERA)

24 COMPOSITE MATERIALS

Includes laminates.

N77-10160*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NITRILE CROSSLINKED POLYPHENYL-QUINOXALINE/GRAPHITE FIBER COMPOSITES
William B. Alston 1976 20 p refs Presented at the 8th Natl. Symp. and Tech. Conf. of the Soc. for the Advan. of Mater. and Process Eng., Seattle, 12-14 Oct. 1976 Prepared in cooperation with Army Air Mobility R and D Lab., Cleveland, Ohio
(NASA-TM-X-73456; E-8815) Avail: NTIS HC A02/MF A01 CSCL 11D

Studies were performed to reduce the 600 F thermoplasticity of polyphenylquinoxaline (PPQ) matrix resins by introducing crosslinking by the reaction of terminal nitrile groups. Seven solvents and solvent mixtures were studied as the crosslinking catalysts and used to fabricate crosslinked PPQ/HMS graphite fiber composites. The room temperature and 600 F composite mechanical properties after short time and prolonged 600 F air exposure and the 600 F composite weight loss were determined and compared to those properties of high molecular weight, linear PPQ/HMS graphite fiber composites. Author

N77-10161# Utah Univ., Salt Lake City. Materials Science and Engineering Div.
IMPURITY EFFECTS ON THE CREEP OF POLYCRYSTALLINE MAGNESIUM AND ALUMINUM OXIDES AT ELEVATED TEMPERATURES Technical Progress Report, 19 Dec. 1974 - 18 Dec. 1975
R. S. Gordon Dec. 1975 82 p refs
(Contract E(11-1)-1591)
(COO-1591-29) Avail: NTIS HC A05/MF A01

Work is reported on: (1) viscous creep of fine grained MgO doped with iron, (2) the effects of transition metal impurities and grain size on the creep of polycrystalline Al2O3, (3) the non-viscous creep of large grain size MgO and Al2O3, pure and doped with transition metal impurities, (4) stress relaxation tests on polycrystalline MgO and Al2O3, pure and doped with transition metal impurities, (5) the construction of creep deformation maps for polycrystalline MgO and Al2O3, pure and doped with iron and, (6) preliminary studies on the effect of grain size on the creep of polycrystalline mullite. Author (ERA)

N77-10162# European Space Agency, Paris (France).
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON LANDING GEAR SPRING BLADES OUT OF FIBER REINFORCED PLASTIC FOR SMALL AIRCRAFT
Rainer Schuetze Sep. 1976 35 p refs Transl. into ENGLISH of "Theoretische u. exptl. Untersuch. an Fahrwerksfederblaettern aus faserverstaerkten Kunststoffen fuer Kleinflugzeuge", DFVLR, Brunswick Report DLR-FB-76-06, 12 Jan. 1976 Original German report available from DFVLR, Cologne DM 16.20
(ESA-TT-312; DLR-FB-76-06) Avail: NTIS HC A03/MF A01

The development of several landing gear spring blades for a small aircraft is described. A special sandwich structure not only minimized the weight of the spring blade but also enabled it to resist both high longitudinal stresses in the facing layers and high shear stresses in the core. The considerable length of these spring blades made it essential for them to have a high flexural rigidity. Carbon and Kevlar 49 fibers, both of which have a greater modulus of elasticity than glass fibers, were therefore used as alternative reinforcements in the facing layers on the tension side of the blades. All the blades were subjected to dynamic and static testing with the help of a gravitational-fall test bed. The use of Kevlar 49 fibers in the tension flange of the sandwich permitted the weight to be reduced even as

compared with the GRP sandwich, and an improved damping behavior was also obtained. Author (ESA)

N77-10244*# Michigan Univ., Ann Arbor.
MOISTURE TRANSPORT IN COMPOSITES
George S. Springer *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 147-156 refs Sponsored by AFML (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10245*# Washington Univ., Seattle.
A HIGH ORDER THEORY FOR UNIFORM AND LAMINATED PLATES
King H. Lo, Richard M. Christensen (Univ. of Calif.), and Edward M. Wu (Univ. of Calif.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol 1 1976 p 157-166 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10246*# Cornell Univ., Ithaca, N.Y.
STOCHASTIC MODELS FOR THE TENSILE STRENGTH, FATIGUE
S. Leigh Phoenix *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 167-181 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10247*# Utah Univ., Salt Lake City.
PROGRESSIVE FAILURE OF NOTCHED COMPOSITE LAMINATES USING FINITE ELEMENTS
Ralph J. Nuismer and Gary E. Brown (Air Force Academy) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 183-192 refs Sponsored by Utah Univ. Research Fund (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10248*# Dayton Univ. Research Inst., Ohio.
RESIDUAL STRESSES IN POLYMER MATRIX COMPOSITE LAMINATES
H. Thomas Hahn *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 193-204 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10293*# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
ENVIRONMENTAL EFFECTS ON POLYMERIC MATRIX COMPOSITES
J. M. Whitney and G. E. Husman *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 687-696 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10296*# Drexel Univ., Philadelphia, Pa. Dept. of Mechanical Engineering and Mechanics.
TRANSFER MATRIX APPROACH TO LAYERED SYSTEMS WITH AXIAL SYMMETRY
Leon Y. Bahar *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 721-729 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

N77-10163 Engineering Sciences Data Unit, London (England).
VAPOUR PRESSURES AND CRITICAL POINTS OF LIQUIDS. 8: ADDITIONAL HALOGENATED ETHANES AND ETHYLENES
Mar. 1976 41 p
(ESDU-76006-8) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $194.50

Vapor pressure data for 16 halogenated ethanes and ethylenes are given in tables and graphs generated from Chebyshev polynomials for which the coefficients are also given. Each compound is fitted by a single equation for the whole range from the melting point to the critical point. Dissert. Abstr.

N77-10164 Engineering Sciences Data Unit, London (England).
VAPOUR PRESSURES AND CRITICAL POINTS OF LIQUIDS. 7: HALOGENATED ETHANES AND ETHYLENES
Mar. 1976 43 p
(ESDU-76004-7) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $434.50

Vapor pressure data for 39 halogenated ethanes and ethylenes and 6 azeotropic mixtures are given in tables and graphs generated from Chebyshev polynomials for which the coefficients are also given. Each compound is fitted by a single equation for the whole range from the melting point to the critical point.
Dissert. Abstr.

N77-10165*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REACTIONS OF CHROMIUM WITH GASEOUS NaCl IN AN OXYGEN ENVIRONMENT
Carl A. Stearns, Fred J. Kohl, and George C. Fryburg 1976 12 p refs Presented at Symp. on Properties of High Temp. Alloys, Las Vegas, Nev., 17-22 Oct. 1976; sponsored by the Electrochem. Soc. and the Met. Soc. of the Am. Inst. of Mining, Met. and Petrol. Engrs.
(NASA-TM-X-73476; E-8748) Avail: NTIS HC A02/MF A01 CSCL 07D

Target collection techniques and high pressure mass spectrometric sampling have been used to study the formation of volatile chromium-containing species in the reaction of Cr_2O_3 with O_2 and NaCl gases. Experiments were performed at atmospheric pressure as a function of chromium temperature, oxygen pressure, and NaCl gas concentration. The major chromium-containing vapor species were found to be $(NaCl)_x CrO_3$ gas, with x = 1,2, and 3, which are products of heterogeneous reactions on the surface. The kinetics indicate first order dependence on oxygen and sodium chloride pressures. Author

N77-10166*# Utah Univ., Salt Lake City. Dept. of Materials Science and Engineering.
PREPARATION AND CHARACTERIZATION OF METHACRYLATE HYDROGELS FOR ZETA POTENTIAL CONTROL Final Report
D. E. Gregonis, S. M. Ma, R. VanWagenen, and J. D. Andrade 15 Feb. 1976 51 p refs
(Contract NAS8-30253)
(NASA-CR-150031; UTEC-76-127) Avail: NTIS HC A04/MF A01 CSCL 07D

A technique based on the measurement of streaming potentials has been developed to evaluate the effects of hydrophilic coatings on electroosmotic flow. The apparatus and procedure are described as well as some results concerning the electrokinetic potential of glass capillaries as a function of ionic strength, pH, and temperature. The effect that turbulence and entrance flow conditions have on accurate streaming potential measurements is discussed. Various silane adhesion promoters exhibited only a slight decrease in streaming potential. A coating utilizing a glycidoxy silane base upon which methylcellulose is applied affords a six-fold decrease over uncoated tubes. Hydrophilic methacrylate gels show similar streaming potential behavior, independent of the water content of the gel. By introduction of positive or negative groups into the hydrophilic methacrylate gels, a range of streaming potential values are obtained having absolute positive or negative signs. Author

N77-10167# Tennessee Univ., Knoxville.
APPLICATION OF THE RADIO-FREQUENCY FURNACE TECHNIQUE TO ENVIRONMENTAL TRACE ANALYSIS, PART 1. THE APPLICABILITY OF HADAMARD TRANSFORM TECHNIQUES TO UV-VISIBLE SPECTROSCOPY,

PART 2 Ph.D. Thesis
R. Crosmun Dec. 1974 174 p refs Sponsored by ERDA
(TID-26947-Pt-1; TID-26947-Pt-2) Avail: NTIS HC A08/MF A01

A radio frequency furnace is described. The application of this atomization source to the analysis of trace environmental samples by atomic absorption is demonstrated. Accuracy on the order of 8 percent at the low ppM level was obtained with such samples. Absolute sensitivities were obtained for zinc, lead, and copper. A detailed description of the principles underlying the multiplex operation of a Hadamard Transform Spectrometer is given. It is determined that the successful operation in the UV-visible region of such an instrument may depend critically upon the type and character of the noise present in the spectrometer system. A detailed quantitative investigation of the noise produced by a large number of common spectrometric sources is described. The power spectra of these sources was obtained by direct Fourier analysis of the output of a selected 1P28 photomultiplier when illuminated by the source of interest. Author (ERA)

N77-10168# Centraal Instituut voor Voedingsonderzoek TNO, Zeist (Netherlands).
MAINTAINABILITY TESTS OF OILS AND FATS, PART 3 [HOUDBAARHEIDSPROEVEN MET OLIEN EN VETTEN 3]
C. Vinkenborg, comp. Aug. 1975 14 p In DUTCH
(Contract A72/KL/154)
(R-4766-Pt-3; TDCK-66767) Avail: NTIS HC A02/MF A01

The maintainability of oils and fats was investigated using the Fira-Astell oxygen absorption apparatus. Hardened fishoil, soybean oil, hydrogenated fishoil and sunflower oil were used for the tests. Powdered peanut samples were also tested. It is concluded that the best sample size is 2 g and that the differences between commercial soybean oil and sunflower oil samples remain during storage. Possibly, factors other than oxidation, for instance iron or phosphorus content, have an influence on storing fats or oils at low or high temperatures. ESA

N77-10169# European Space Agency, Paris (France).
SPECTROSCOPIC DIAGNOSTICS OF HYDROGEN/OXYGEN FLAMES
Peter Frank, L. Krauss et al Jan. 1976 50 p refs Transl. into ENGLISH of "Spektroskopische Diagnostik an Wasserstoff-Sauerstoff-Flammen", DFVLR, Stuttgart Report DLR-FB-74-65, 12 Sep. 1974 Original German report available from DFVLR, Porz, West Ger. DM 16.50
(ESA-TT-246; DLR-FB-74-65) Avail: NTIS HC A03/MF A01

Some spectroscopic procedures were applied for determination of temperature distributions in premixed H2/O2-flames, and the results of measurements are discussed. The flames were seeded with indicator elements (Na, Li, Al) for the evaluation of population densities (population temperatures) by means of the two-line method and the emission-absorption method (line-reversal). Information was obtained on rotational as well as vibrational temperatures within the exhaust gases from the emission of molecules as AlO, formed in the flame. Measured number densities of different species were tested by using a computer program for formation processes of radicals.
Author (ESA)

N77-10170# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
COHERENT ANTI-STOKES RAMAN SCATTERING APPLICATION TO GAS CONCENTRATION MEASUREMENTS IN AERODYNAMIC FLOWS Ph.D. Thesis - Paris Univ.
Francois Moya 1976 65 p refs In FRENCH; ENGLISH summary Report will also be announced as translation
(ONERA-NT-1975-13) Avail: NTIS HC A04/MF A01

The spontaneous Raman effect and performance achieved in gas concentration and temperature measurements using instruments based on the coherent antistokes Raman scattering are reviewed, including the characteristics of coherent antistokes Raman scattering and its limitations when applied to gas concentration measurements. The equipment, a ruby laser associated with a stimulated Raman oscillator and ruby laser associated with a dye laser, is described and experimental results obtained using both instruments are discussed. The vibrational transition line profiles Q(J) of hydrogen, oxygen, and nitrogen were obtained at 300 K, as well as concentration and temperature measurements of hydrogen created within a gaseous flame. It is concluded that the coherent antistokes Raman scattering could be applied to detection of atmospheric pollutant detection. Author (ESA)

N77-10171# European Space Agency, Paris (France).
DYNAMICS OF CHEMICAL REACTIONS AT A STAGNATION POINT ILLUSTRATED FOR THE COMBUSTION OF CARBON
Werner Haase Sep. 1976 73 p refs Transl. into ENGLISH of "Stabilitaetsuntersuch. chem. Reaktionen in einer Staupunktgrenzschicht am Beispiel einer Kohlenstoff-Verbrennung", Tech. Univ. Berlin Report DLR-FB-76-03, 1976 Original German report available from DFVLR, Cologne DM 27.90
(ESA-TT-305; DLR-FB-76-03) Avail: NTIS HC A04/MF A01

Resulting from the unstable boundary layer equations, similar solutions for a stagnation point boundary layer are given. The system of equations consists of the unstable balance equations for momentum, energy and conservation of a particular species. Numerical solutions due to the C-O reaction illustrated are carried out with both the heterogeneous surface reactions and homogeneous reactions in the gas phase, including associated backward reactions taken into consideration. In contrast to a linear stability theory, which is limited in scope as it is based on linearized equations and, therefore, only gives the response to very small disturbances, this system gives extensive reaction developments, as well as frequencies and amplitudes of temperature and concentration oscillations. Author (ESA)

N77-10172# Rutgers Univ., New Brunswick, N.J. Dept. of Biochemistry and Microbiology.
COLLAGEN-IMMOBILIZED ENZYME SYSTEMS
W. R. Vieth and K. Venkatasubramanian 1975 38 p refs (Grants NSF GI-34287; NSF GK-14075; NSF GK-28866)
(PB-252540/0; NSF/RA/T-75-062) Avail: NTIS HC A03/MF A01 CSCL 06A

Methods of preparation of collagen enzyme and collagen whole cells membranes are outlined. Procedures for the determination of (1) activity of the conjugated preparations, (2) amount of bound enzyme, (3) stability, and (4) kinetic and mass transfer parameters are described. A method of fabrication of spiral wound reactors containing collagen membrane is also presented. GRA

N77-10173# Bureau of Mines, Amarillo, Tex. Helium Operations.
MASS SPECTROMETER METHOD FOR DETERMINING PARTS PER BILLION HELIUM-3 IN HELIUM Report of Investigations, 1976
David E. Emerson and Elmer T. Suttle Mar. 1976 16 p refs
(PB-252474/2; BM-RI-8119) Avail: NTIS HC A02/MF A01 CSCL 18B

A mass spectrometer method for determining the helium 3 content of high-purity helium was developed. The work was done in order to evaluate experimental methods for removing helium 3 from high purity helium and to better determine the composition of pure helium used in research. This was accomplished by increasing the inlet sample pressure, ionizing current, and amplification of the current produced by the ions collected on a conventional mass spectrometer that had been modified. With these modifications, the helium 3 content was determined in the parts per million and parts per billion range in helium 4. GRA

N77-10174# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
STEADY-STATE PARAMETER-JUMP METHODS AND RELAXATION METHODS IN THERMOGRAVIMETRY Final Report
Joseph H. Flynn and Brian Dickens Jun. 1975 18 p refs Presented at the 5th N. Am. Thermal Anal. Soc. Meeting, Peterborough, Canada, 8-11 Jun. 1975 Submitted for publication Sponsored in part by Navy
(PB-252433/8) Avail: NTIS HC A02/MF A01 CSCL 07D

A technique is described for thermogravimetric analysis in which the magnitude of a rate-forcing variable such as temperature, pressure, gaseous flow rate, gaseous composition, etc., is

jumped by discrete steps. Kinetic relationships between the rate of weight loss and the jumped variable can be determined. The disparate effects of separate experimental histories in methods in which two or more experiments are compared are avoided. The necessity for guessing the often complex rate versus extent of reaction relationship in methods where the rate forcing variable is changed continuously in a single experiment is also avoided. The method is illustrated with examples from the oxidation of polystyrene. GRA

N77-10175# National Bureau of Standards, Washington, D.C.
COLLISION-INDUCED O SINGLET D(2)-SINGLET S(0) EMISSION NEAR 5577 ANGSTROM IN ARGON Interim Report
P. S. Julienne, M. Krauss, and W. Stevens 3 Dec. 1975 10 p refs Submitted for publication Sponsored in part by ERDA
(PB-252437/9) Avail: NTIS HC A02/MF A01 CSCL 07D

The collision-induced emission near the 5577 A oxygen singlet D(2) - single S(0) transition in argon is investigated theoretically. Approximate ArO model potentials were constructed for the upper and lower states by adding the attractive long range dispersion energy to the short range repulsion calculated ab initio. The thermally averaged free free, free bound, and bound bound contributions to the emission profile were calculated using the long range quadrupole-induced dipole transition moment. The calculated bound bound spectrum and the total emission coefficient agree well with experiment. GRA

N77-10176# Maryland Univ., College Park. Dept. of Textiles and Consumer Economics.
AN INVESTIGATION OF TEST METHODS FOR DETERMINING THE FLAMMABILITY HAZARDS OF FABRICS Final Report
Kwan-nan Yeh, Ira Block, B. F. Smith, and Steven Spivak 1975 67 p
(Contract NBS-3-9007)
(PB-254748/7; NBS-GCR-76-70) Avail: NTIS HC A04/MF A01 CSCL 11E

The measurement of char length and burn time of a variety of sample specimens was conducted to determine the effects of varying sample size, sample shape, ignition source and air flow past the sample, on these two parameters. Flammability test methods should conform to the following guidelines: (1) the suspension method should be such as to exert as little force in the plane of the fabric as possible; (2) the test specimen should be wide enough to permit unlimited burning in all directions; (3) the ignition source should be capable of providing a precise energy input at a constant rate to the fabric; (4) a forced air flow through the cabinet may be required; (5) moisture sorption; and (6) seamed samples are unnecessary except where the added thread is a significant portion of the weight of the fabric under test. GRA

N77-10177# Massachusetts Inst. of Tech., Cambridge. Fibers and Polymers Div.
EXTINGUISHMENT IN APPAREL TEXTILES Final Report
G. Tesoro and S. Backer Oct. 1975 60 p refs
(Contract NBS-4-9024)
(PB-254751/1; NBS-GCR-76-71) Avail: NTIS HC A04/MF A01 CSCL 11E

The extinguishability during combustion of various apparel fabric was investigated. Cotton, wool, nylon, cotton/polyester and FRI cotton/polyester were ranked according to burning behavior under test conditions including the addition of heat sinks near the fabric. Stationary and movable heat sinks of various thermophysical properties, geometries, dimensions and speeds were considered. It was found that extinguishability is affected by fiber type and finish, by weight per unit area and structure. Parameters identified to measure relative extinguishability were the minimum constant spacing (between fabric and heat sink) needed to induce extinguishment, and the maximum char length obtained after extinguishment in the case of a variable fabric to heat sink spacing. It was concluded that relative differences in ease of extinguishment of nonthermoplastic fabrics can be quantitatively and reproducibly measured. GRA

N77-10178# Office of Naval Research, London (England).
FARADAY SYMPOSIUM ON PROTON TRANSFER
A. L. Powell (ONR, Boston) 9 Mar. 1976 10 p Held at Stirling Univ., Scotland, 8-11 Sep. 1975
(AD-A024033; ONRL-C-8-76) Avail: NTIS HC A02/MF A01 CSCL 07/4

This report summarizes research progress in the field of proton transfer in chemical reactions in solution discussed at a Faraday Society symposium held at the University of Stirling, Scotland on 8-11 September 1975. At this conference, R. P. Bell, a recognized world leader in the field, was honored on the occasion of his retirement from the University of Stirling and delivered the Spiers Memorial Lecture. Author (GRA)

N77-10179# National Bureau of Standards, Washington, D.C.
MECHANISTIC STUDIES OF PHOSPHORUS CONTAINING FLAME RETARDANTS Final Report
C. L. McBee and J. W. Hastie 1976 12 p refs Presented at Proc. of 1975 Intern. Symp. on Flammability and Fire Retardants, Montreal, 22-23 May 1975 p 253-263 Submitted for publication
(PB-255670/2) Avail: NTIS HC A02/MF A01 CSCL 07C

A combination of mass spectrometric and optical spectroscopic studies has been made to establish a mechanism for phosphorous controlled flame retardancy in thermoplastics. A vapor phase mode of flame inhibition can account for the known flame retardancy effect of triphenylphosphine oxide in polyester substrates. GRA

N77-10180# National Bureau of Standards, Washington, D.C. Center for Fire Research.
FLAMMABILITY LIMITS. THERMODYNAMICS AND KINETICS Final Report
Andrej Macek May 1976 28 p refs
(PB-254180/3; NBSIR-76-1076) Avail: NTIS HC A03/MF A01 CSCL 21B

Extinction limits for both premixed and diffusion flames for n-alkanes and n-alcohols are assembled. Several sets of theoretical flame temperatures corresponding to the limits are defined and presented. The implications of the view that flames fail to propagate at temperatures at which reaction rates become too low to overcome the dissipation processes are discussed. Equilibrium flame temperatures indicate that at lean limits the excess oxygen does not act merely as a diluent but takes an active part in promoting the kinetics of flame reactions. The burning-rate data and the results of ignition experiments are shown to be pertinent to the interpretation of flammability limits. GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N77-10181# Royal Aircraft Establishment, Farnborough (England).
THE ROLE OF STACKING FAULT ENERGY IN HIGH TEMPERATURE CREEP. PART 2: CREEP OF ALUMINUM, NICKEL, COPPER AND SILVER
A. Orlova Jun. 1976 17 p refs Transl. into ENGLISH from Kovove Mater. (Czechoslovakia), v. 3, no. 7, 1969 p 242-253
(RAE-Lib-Trans-1892; BR53960-Pt-2) Avail: NTIS HC A02/MF A01; HMSO; PHI

The creep behavior of aluminum, nickel, copper and silver is shown to be controlled by lattice self-diffusion. The influence of stacking fault energy, gamma, on creep rate, epsilon, is through a power law of the form epsilon is proportional to gamma super K. This has been reported previously but unlike the earlier work, the exponent, K, is approximately 2.6. Studies of dislocation substructure clearly demonstrate the manner in which stacking fault energy influences behavior and suggests that the rate controlling event is the nonconservative glide of jogged dislocations. Author

N77-10182# Royal Aircraft Establishment, Farnborough (England).
TEXTURE STRENGTHENING OF TITANIUM AND ZIRCONIUM

N. V. Ageev and A. A. Babareko May 1975 17 p refs Transl. into ENGLISH from Izvest. Akad. Nauk. SSSR, Metally 2 (USSR), 1975 p 81-90
(RAE-Lib-Trans-1894; BR53961) Avail: NTIS HC A02/MF A01

The development of crystallographic textures and the corresponding effects on strength and hardness in Ti, Zr, and their alloys were studied. The addition of alpha or beta stabilizing elements to Ti, for example, changed the tendency towards dislocation formation, and encouraged the development of the base texture. By varying the temperature, the deformation rate, and the amount of reduction during rolling, in addition to the orientation of the principal deforming forces, the type of crystallographic texture developed in alpha and (alpha + beta) Ti alloys assumed various predictable forms, many of which gave special mechanical properties to parts made from these alloys. Analogous effects were obtained for Zr. Author

N77-10183*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HOT CORROSION STUDIES OF FOUR NICKEL-BASE SUPERALLOYS: B-1900, NASA-TRW VIA, 713C AND IN738
George C. Fryburg, Fred J. Kohl, and Carl A. Stearns 1976 11 p refs Presented at Symp. on Properties of High Temp. Alloys, Las Vegas, Nev., 17-22 Oct. 1976; sponsored by the Electrochem. Soc. and the Met. Soc. of the Am. Inst. of Mining, Met. and Petrol. Engrs.
(NASA-TM-X-73479) Avail: NTIS HC A02/MF A01 CSCL 11F

The susceptibility to hot corrosion of four nickel base superalloys has been studied at 900 deg and 1000 deg C in one atmosphere of slowly flowing oxygen. Hot corrosion was induced by coating the samples with known doses of NaSO4 and oxidizing the coated samples isothermally on a sensitive microbalance. In general, the order of susceptibility found was: B-1900 is greater than 713C is greater than NASA-TRW VIA and is greater than IN738. This order corresponds to the order of decreasing molybdenum content of the alloys. Chemical evidence for B-1900 indicates that hot corrosion is instigated by acid fluxing of the protective Al2O3 coating by MoO3.
Author

N77-10184# Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.
FUNDAMENTAL STUDIES OF METAL FLUORINATION REACTION Annual Progress Report
Robert A. Rapp 28 Jan. 1976 28 p refs
(Contract E(11-1)-2671)
(COO-2671-1) Avail: NTIS HC A03/MF A01

Solid state electrochemical methods are being used to determine structural, thermodynamic, and transport properties in materials pertinent to the fluorination of metals at elevated temperatures. The solubility and diffusivity of fluorine in solid metals (initially nickel) are being studied by a potentiostatic electrochemical procedure by which changes in an impressed cell voltage induces changes in the activity of fluorine at a metal/electrolyte interface while the recording of the resulting cell current as a function of time can be interpreted to yield the desired quantities. Defect structures in metal fluoride compounds are being studied through measurements and interpretation of the electrical conductivity. The variation in the conductivities of the pure and impurity-doped compound as a function of fluorine activity can be interpreted to establish the partial ionic and electronic conductivities of the compounds, and the concentrations and mobilities of the carriers. Author (ERA)

N77-10185# California Univ., Berkeley. Lawrence Berkeley Lab.
ELECTRON PARAMAGNETIC RESONANCE STUDIES OF THE RELAXATION OF COPPER (II), TITANIUM (III) AND VANADYL IONS IN SOLUTION Ph.D. Thesis
R. C. Wilson Nov. 1973 114 p refs
(Contract W-7405-eng-48)
(LBL-4162) Avail: NTIS HC A06/MF A01

The EPR Spectra of solutions of vanadyl acetylacetonate in liquid ammonia, at X-band (9 GHz), were determined as a function of temperature. The EPR spectra of Cu(NH3)6(2+) were also studied in liquid ammonia, at X-band, as a function of temperature. The EPR spectra of acidified aqueous solutions of Ti (III) were observed both above and below the freezing point. ERA

N77-10186# Oak Ridge National Lab., Tenn.
INTERFACE STABILITY DURING THE OXIDATION OF BINARY ALLOYS
G. J. Yurek Apr. 1976 28 p refs
(Contract W-7405-eng-26)
(ORNL-5116) Avail: NTIS HC A03/MF A01

The stability of a planar alloy/scale interface during the diffusion-controlled oxidation of a homogeneous, single phase binary alloy depends on both the thermodynamic and transport properties of the system under consideration. A criterion is presented that can be employed to predict the stability of a planar alloy/scale interface for the specified reaction temperature, alloy composition, and chemical potential of the oxidant when only one component of the alloy is oxidized, anion diffusion predominates in the scale, and the solubility of oxygen in the alloy is essentially zero. A planar alloy/scale interface (a single-phase scale) is the preferred growth morphology if diffusion in the oxide phase is the rate-limiting step of the oxidation reaction. An uneven alloy/scale interface (a two-phase scale) is expected if diffusion in the alloy phase is the rate determining step. This stability criterion is equivalent to the criterion derived by Wagner for the case of predominant cation diffusion in the scale. ERA

N77-10187# Sandia Labs., Albuquerque, N.Mex.
HELIUM IMPLANTATION EFFECTS IN SAP AND ALUMINUM
W. Bauer and G. J. Thomas Feb. 1976 21 p refs
(Contract AT(29-1)-789)
(SAND-75-8756) Avail: NTIS HC A02/MF A01

A series of 300 KeV He implantations of Al and SAP 930 have been conducted at temperatures between 150 and 773K. The He re-emission was monitored during implantation and the samples were examined with a scanning electron microscope after implantation. Both Al and SAP 930 were found to blister after a critical He dose was reached at temperatures above 473K, both underwent flaking below that temperature, with blistering re-appearing in SAP 930 at an implantation temperature of 150K. The surface deformation and He re-emission are strongly dependent on microstructural effects in the intermediate temperature regime. ERA

N77-10188# Nederlandse Scheeps-Studiecentrum TNO, Delft. Engineering Dept.
A COMPARATIVE LABORATORY INVESTIGATION OF MATERIALS FOR MARINE DIESEL ENGINE FUEL NOZZLES
J. W. Tichler and A. W. J. deGee (Metal Res. Inst. TNO, Apeldoorn, Neth.) Dec. 1974 13 p refs
(Rept-220-M; TDCK-66885) Avail: NTIS HC A02/MF A01; Ned. Scheepsstudiecentrum TNO, Delft DFI. 10

Malfunctioning of fuel injectors for marine diesel engines, made from carburized steel 16 NiCr 11 was related to erosive wear of the orifices because of cavitation in the expanding fuel. A typical feature of this type of attack is the formation of deep craters in the surface. In a laboratory test program, 11 injector nozzle materials were screened with respect to their resistance to this type of surface deterioration. Included were two carburizing steels, six nitriding steels, two chromium plated surfaces and a stellite type cobalt alloy. The nitriding steels underwent salt bath nitriding as well as gas nitriding treatments. It was found that use of the cobalt alloy, instead of carburized 16 NiCr 11 steel, results in an increase in time to crater formation by a factor of about 5. The same or an even better result may be obtained by using gas nitrided surfaces of nitriding steels with aluminum as the nitrogen binding element. Salt bath nitrided surfaces and chromium plated surfaces give some improvement over carburized 16 NiCr 11 steel, but the effect is not very pronounced (a factor of about 2). Practical experience with gas nitrided surfaces tends to corroborate these laboratory test results. Author (ESA)

N77-10189# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost.

THE INFLUENCE OF HF IN CrO3-H2SO4
P. F. A. Bijlmer 18 Apr. 1974 7 p
(FOK-R-1773) Avail: NTIS HC A02/MF A01

The replacement of the thermal activator in chromic sulfuric acid by HF and the etch rate and surface morphology after pickling were investigated. ESA

N77-10190# British Steel Corp., Sheffield (England). Information Services.
THE INVESTIGATION OF AN IRON CORRECTION METHOD IN OPTICAL EMISSION SPECTROSCOPY
A. Butterworth Apr. 1976 15 p refs
(PB-254200/9; GS/TECH/725/1/75/C) Avail: NTIS HC A02/MF A01 CSCL 11F

The performance of the optical emission spectrometer (UVAQ) is reported. With the exception of the manganese and silicon lines which were originally in the air spectrometer section, the instrument was shown to be functioning to the manufacturers specification. However new lines for these elements have been added to the vacuum spectrometer of the instrument and their performance has since been found to be satisfactory. The UVAQ was calibrated to cover the analysis of steels with iron concentration greater than approximately 98%. Because of the nature of the workload in the laboratory it has now been found necessary to extend these calibration ranges so that steels with a higher alloying content can be analyzed. GRA

N77-10191# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
LOW TEMPERATURE FRACTURE BEHAVIOR OF A Ti-6Al-4V ALLOY AND ITS ELECTRON BEAM WELDS
R. L. Tobler Apr. 1976 49 p refs Sponsored by AFWL
(PB-254459/1; NBSIR-76-836) Avail: NTIS HC A03/MF A01 CSCL 11F

The effects of electron beam welding on the fracture behavior of a recrystallization annealed, extra low interstitial Ti-6Al-4V alloy have been investigated at temperatures in the ambient to cryogenic range. Plane strain fracture toughness and subcritical crack growth parameters were measured using compact specimens 10 to 25.4 mm thick. These parameters can be used to predict the safe operating lifetimes of cryogenic pressure vessels and other welded Ti-6Al-4V structures. GRA

N77-10192# Effects Technology, Inc., Santa Barbara, Calif.
FRACTURE TOUGHNESS DATA FOR FERRITIC NUCLEAR PRESSURE VESSEL MATERIALS. TASK A: VOLUME 1 Final Report
R. A. Wullaert, W. Oldfield, and W. L. Server Apr. 1976 80 p refs
(PB-254694/3; EPRI-NP-121-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 18J

The object of the testing program was to evaluate heat to heat variability in fracture toughness of ferritic nuclear pressure vessel steels which are currently described by the reference toughness curve K sub IR relationship found in the ASME boiler and pressure vessel code. Eight types of nuclear pressure vessel steels and weldments (total fifty heats) were studied. Tests performed over a range of temperature included tensile, drop weight-NDTT, Charpy V-notch, instrumented precracked Charpy, static and dynamic compact fracture and dynamic bend. New testing and data analysis procedures were established to deal with the dynamic fracture toughness measurements. GRA

N77-10193# Iowa Univ., Iowa City. Div. of Materials Engineering.
ON THE EFFECT OF HYDROGEN EMBRITTLEMENT ON FRACTURE PROPERTIES OF STEEL Final Report
K. C. Valanis, S. T. Hwang, H-C. Wu, E. Mielnik, and R. Stephens 23 Mar. 1976 111 p refs
(Grant DAHC04-74-G-0150)
(AD-A023947; G385-DME-76-003; ARO-12522.1-MS-A) Avail: NTIS HC A06/MF A01 CSCL 11/6

In this report it is shown that the observed reduction in fatigue life as well as the exhaustion of ductility of uniform steel specimens due to the presence of interstitial hydrogen can be modelled theoretically as a result of the 'Intrinsic Time to Failure' hypothesis recently introduced by Valanis. Laws of interaction between hydrogen diffusion and mechanical deformation of steel, that predict quantitatively and for the first time the observed deflection of a steel beam in the presence of interstitial hydrogen have been found. GRA

N77-10194# Army Materials and Mechanics Research Center, Watertown, Mass.
MAGNETIC BEHAVIOR OF HIGH-DENSITY POWDER METALLURGY BODIES Final Report
Saul Isserow and Harold P. Hatch Mar. 1976 19 p
(DA Proj. 1T1-61101-A-91A)
(AD-A024637; AMMRC-TR-76-10) Avail: NTIS HC A02/MF A01 CSCL 11/6

Magnetic permeability of high-density powder metallurgy bodies was investigated for possible application to nondestructive characterization of residual porosity. The same iron-base bodies were used for measurements of electrical resistivity and ultrasonic velocity. Author (GRA)

N77-10195# Aluminum Co. of America, Alcoa Center, Pa. Alcoa Labs.
DESIGN MECHANICAL PROPERTIES, FRACTURE TOUGHNESS, FATIGUE PROPERTIES, EXFOLIATION AND STRESS-CORROSION RESISTANCE OF 7050 SHEET, PLATE, HAND FORGINGS, DIE FORGINGS AND EXTRUSIONS Final Report, 12 May 1972 - 12 Nov. 1974
R. E. Davies, G. E. Nordmack, and J. D. Walsh Jul. 1975 301 p refs
(Contract N00019-72-C-0512)
(AD-A024609) Avail: NTIS HC A14/MF A01 CSCL 11/6

The mechanical properties, including fracture toughness and fatigue, fatigue-crack growth rates and corrosion characteristics have been determined for a total of 51 lots of 7050-T76 sheet, 7050-T73651 plate, 7050-T73652 hand forgings, 7050-T736 die forgings and 7050-T76511 extruded shapes. Tables of computed design mechanical properties, modulus of elasticity values and individual stress-strain curves are presented. The critical stress-intensity factor, (K sub c), was determined for samples of each lot of sheet and the plane-strain stress-intensity factor, (K sub Ic), was determined for plate, hand and die forgings and extruded shapes. The combination of strength and toughness of all products are generally comparable to or higher than those of conventional 7XXX alloys. Axial-stress fatigue strengths were determined in ambient-air and salt-fog environments. Modified Goodman diagrams were developed from tests made in ambient air. GRA

N77-10196# Battelle Memorial Inst., Richland, Wash.
THE SPUTTER DEPOSITION AND EVALUATION OF TUNGSTEN AND CHROMIUM FOR USE IN WEAPONS COMPONENTS
R. H. Jones, R. W. Moss, E. D. McClanahan, and H. L. Butts Oct. 1975 56 p refs
(AD-A024109; RIA-R-TR-75-042) Avail: NTIS HC A04/MF A01 CSCL 13/8

This work was conducted to establish sputter deposition as a candidate production coating process for military items. Specifically two areas were evaluated -- deposition on internal bore surfaces of gun barrels and deposition of wear resistant coatings on external surfaces. The feasibility of sputter deposition on bore surfaces of 7.62mm gun tubes was studied using both a modified dc-triode scheme with tungsten targets centered on the gun tube axis and a dc-diode scheme with the plasma supported by thermally emitted electrons from a hot target/filament centered on the gun tube axis. Although the latter scheme gave better deposition characteristics, further refinements appear necessary before the method can be adapted as a production coating process. High quality chromium coatings were produced on 7076-T6 aluminum substrates in the work involving deposition on external surfaces. The wear test results indicate the sputter deposited chromium coatings exhibited superior substrate adherence and more uniform wear characteristics when compared to the electro-deposited chromium plating. Author (GRA)

N77-10231*# Carnegie-Mellon Univ., Pittsburgh, Pa. Center for the Joining of Materials.
MICROSCOPIC ASPECTS OF INTERFACIAL REACTIONS IN DIFFUSION BONDING PROCESSES
Michael P. Shearer and Charles L. Bauer *In* NASA. Langley

Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 3-35 refs Sponsored by NSF (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10232*# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.
MACROSCOPIC ASPECTS OF INTERFACIAL REACTIONS
R. W. Heckel *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 15-35 refs Sponsored by NSF (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10235*# Michigan Univ., Dearborn.
A CRITICAL REVIEW OF THE EFFECTS OF MEAN AND COMBINED STRESSES ON FATIGUE LIMIT OF METALS
R. E. Little *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 51-65 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10238*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
ON ONSAGERS PRINCIPLE, DISLOCATION MOTION AND HYDROGEN EMBRITTLEMENT
M. R. Louthan, Jr. and R. P. McNitt *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 77-84 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10243*# Joint Inst. for Advancement of Flight Sciences, Washington, D. C.
COMPUTER SIMULATION OF SCREW DISLOCATION IN ALUMINUM
Donald M. Esterling *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 137-146 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N77-10197*# Kanner (Leo) Associates, Redwood City, Calif.
SPRAYING BY WIRE EXPLOSION: A NEW METHOD OF SURFACE COATING TECHNOLOGY
H. Grabatin and H.-D. Steffens Washington NASA Sep. 1976 13 p refs Transl. into ENGLISH from Jahrbuch der Oberflaechentechnik. (Berlin), vol. 32, 1976 p 257-265
(Contract NASw-2790)
(NASA-TT-F-17212) Avail: NTIS HC A02/MF A01 CSCL 11C

The technique under consideration is used basically for the application of thin metal or metal/ceramic coatings. The coatings employed have a thickness in the range from 10 to 300 microns. The principles of operation of this spraying technique are examined, taking into account capacitive energy storage devices for the wire explosion, the electrical discharge circuit, and problems involved in the optimal utilization of the energy. Attention is also given questions of coating application, the coating materials, and the characteristics of the sprayed coatings. Author

N77-10198*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NOZZLE EXTRACTION PROCESS AND HANDLEMETER FOR MEASURING HANDLE Patent Application
Vernon L. Alley, Jr. and Austin P. McHatton, inventors (to NASA) Filed 19 Oct. 1976 29 p
(NASA-Case-LAR-12147-1; US-Patent-Appl-SN-733825) Avail: NTIS HC A03/MF A01 CSCL 11E

A method and apparatus for quantitatively measuring the handle of fabrics and other flexible materials is described. Handle is that term used to refer to the qualities of drapability, flexibility, compressibility, foldability, stretchability, pliability, etc., possessed by fabrics and other flexible materials. The handle of a material sample is quantified by measuring the force required to draw the sample through an orifice and expressing the resultant extractive force as a function of test apparatus geometry and the amount of sample drawn through the orifice. A quantative measure of handle is determined by a circular sectional convergent nozzle, to be defined as handle modulus, for the sample in question. Official Gazette of the U.S. Patent Office

N77-10199*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GASEOUS EMISSIONS AND TOXIC HAZARDS ASSOCIATED WITH PLASTICS IN FIRE SITUATIONS: A LITERATURE REVIEW
Thomas L. Junod Oct. 1976 67 p refs
(NASA-TN-D-8338; E-8549) Avail: NTIS HC A04/MF A01 CSCL 11I

The hazards of plastics in fire situations, the gases emitted, the factors influencing the nature of these emissions, the characteristics of toxic gases, and the results of laboratory studies, are discussed. The literature pertaining to the pyrolysis and oxidation of plastics was reviewed. An effort was made to define the state of the art for determining the toxic gases emitted by plastics under fire conditions. Recommendations are made and research needs defined as a result of this review. Author

N77-10200*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONELASTOMERIC ROD SEALS FOR ADVANCED HYDRAULIC SYSTEMS
William F. Hady and Alvin W. Waterman 1976 25 p refs Presented at A-6 Meeting on Aerospace Fluid Power and Control Technologies, Las Vegas, Nev., 4-8 Oct. 1976; sponsored by SAE
(NASA-TM-X-73525; E-8940) Avail: NTIS HC A02/MF A01 CSCL 11I

Advanced high temperature hydraulic system rod sealing requirements can be met by using seals made of nonelastomeric (plastic) materials in applications where elastomers do not have adequate life. Exploratory seal designs were optimized for advanced applications using machinable polyimide materials. These seals demonstrated equivalent flight hour lives of 12,500 at 350 F and 9,875 at 400 F in advanced hydraulic system simulation. Successful operation was also attained under simulated space shuttle applications; 96 reentry thermal cycles and 1,438 hours of vacuum storage. Tests of less expensive molded plastic seals indicated a need for improved materials to provide equivalent performance to the machined seals. Author

N77-10201*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REACTION CURED GLASS AND GLASS COATINGS Patent Application
Howard E. Goldstein, Daniel B. Leiser (Stanford Univ., Calif.), and Victor E. Katvala, inventors (to NASA) Filed 29 Oct. 1976 19 p
(NASA-Case-ARC-11051-1; US-Patent-Appl-SN-726910) Avail: NTIS HC A02/MF A01 CSCL 11C

Reaction cured glass and glass coating are prepared by reacting a compound from the group of compounds consisting of silicon tetraboride, silicon hexaboride, other boron silicides, boron and mixtures thereof with a reactive glass frit composed of a porous high silica borosilicate glass and boron oxide. The glassy composites are useful as coatings on low density fiberous porous silica insulations used as heat shields and for articles such as reaction vessels that are subjected to high temperatures with rapid heating and cooling and that require resistance to temperature and repeated thermal shock at temperatures up to about 1482 C (2700PF). NASA

N77-10202# Sandia Labs., Albuquerque, N.Mex.
WETTING OF A POLYCRYSTALLINE ALUMINA BY GLASS
C. M. Kramer Feb. 1976 24 p refs
(Contract AT(29-1)-789)
(SAND-75-8051) Avail: NTIS HC A02/MF A01

Contact angles were measured in sessile drop experiments of Corning 7052 glass on various polycrystalline alumina substrates and on an alumina/niobium cermet substrate between 700 and 1100 C. The alumina glass systems illustrated dynamic

nonequilibrium situations. Solid state sintering by viscous flow of the glass was observed below 1000 C. Surface tension values were computed for the glass and ranged between 80 and 600 dynes/cm. Author (ERA)

N77-10203# California Univ., Berkeley. Lawrence Berkeley Lab.
HIGH VOLTAGE ELECTRON MICROSCOPE STUDIES OF CERAMIC FERRITES
G. Thomas Sep. 1975 11 p refs Presented at 4th High Voltage Electron Microscopy Conf., Touliuse, France, 1 Sep. 1975
(Contract W-7405-eng-48)
(LBL-4114; Conf-750982) Avail: NTIS HC A02/MF A01

Results of studies on defects and phase transformations in ceramic ferrites are presented. Data and information are included on order disorder in lithium ferrite, high temperature phase transformation in lithium ferrite, stacking faults in nickel ferrite, cation faults in lithium ferrite, and disassociated dislocations and stacking fault energy in lithium ferrite. ERA

N77-10204# United Kingdom Atomic Energy Authority, Harwell (England). Materials Development Div.
THE SELECTION AND PROCESSING OF CARBON FIBRE REINFORCED ACETAL FOR GEAR APPLICATIONS IN SATELLITES Final Report
D. C. Phillips and J. M. Scott Apr. 1976 37 p refs
(Contract ESTEC-2255/74-AK)
(AERE-R-8351; ESA-CR(P)-815) Avail: NTIS HC A03/MF A01

Results on a study on the possibilities of using carbon fiber reinforced acetal (CFA) in satellite gears are presented. Sources of supply of CFA are reviewed and an evaluation of the optimum processing conditions is given. A procedure for the production of CFA gear blanks, using injection moulding, is described. ESA

N77-10205# European Space Research and Technology Center, Noordwijk (Netherlands). Product Assurance Div.
APPLICATION AND TESTING OF CUVERTIN 306, A BLACK PAINT FOR SPACECRAFT USE
Paris ESA 1 Dec. 1975 15 p
(ESA-PSS-21/QRM-14P-ESTEC-Iss-1) Avail: NTIS HC A02/MF A01

Requirements for producing a low-outgassing matte black coating for spacecraft use are defined. Cuvertin 306 is a polyurethane paint cured by reaction with the water vapor present in air. The tests to be carried out on the paint are specified. ESA

N77-10206# European Space Agency, Paris (France).
INVESTIGATION OF MASS LOSS RATE AND INTERNAL TEMPERATURE DEVELOPMENT OF SIMPLE CYLINDRICAL ABLATING BODIES
Knud Kindler Sep. 1976 101 p refs Transl. into ENGLISH of "Untersuch. der Massenabtragung u. der Entwicklung der innentemperatur bei einfachen axialsymmetrischen Ablationskoerpern", DFVLR, Cologne Report DLR-FB-76-23, 25 Mar. 1976 Original German report available from DFVLR, Cologne DM 38.60
(ESA-TT-319; DLR-FB-76-23) Avail: NTIS HC A06/MF A01

Experimental and numerical results on the ablation of polytetrafluoroethylene are presented. The experimental data were obtained in air flow of an arc heated wind tunnel. The main purpose of the one-dimensional unsteady calculations is the consideration of the influence of the boundary condition on the ablation process; in particular the effect of the optical transparency of the amorphous part was investigated. Author (ESA)

N77-10207# California Univ., Berkeley. Dept. of Chemical Engineering.
POLYBLENDS OF POLY(STYRENE-B-BUTADIENE-B-STYRENE) AND POLYSTYRENE. 1: MECHANICAL PROPERTIES
G. Akovali, J. Diamant, and M. Shen 1 Apr. 1976 32 p refs Submitted for publication
(Contract N00014-75-C-0955)
(AD-A023167; TR-5) Avail: NTIS HC A03/MF A01 CSCL 11/10

Kraton 1101, a styrene-butadiene-styrene triblock copolymer (SBS), was blended with homopolymers of styrene (PS) of various molecular weights by dissolving in mutual solvents. All polyblends cast from mixed solvents of tetrahydrofuran and methyl ethyl ketone were found to be plastic-like. Stress-strain curves of these materials all exhibited a yield point, and a flat drawing region. Samples can be stretched beyond 500% strain without fracture. Blends containing high amounts of added PS (= 40%) showed stress-whitening effects. Most samples undergo necking when strained beyond the yield point. However, the necked regions are rubbery and exhibit high elasticity rather than irreversible drawing. Dynamic mechanical data of stretched and unstretched polyblends show that the former have enhanced loss tangent region between the primary glass transition loss peaks of styrene and butadiene blocks. The increased loss tangent is due to the decreased storage modulus values of the stretched samples, while the loss moduli remained unchanged. Stress-strain data of gradient (layered) polyblends are also presented. GRA

N77-10208# Martin Marietta Labs., Baltimore, Md.
SURFACE-CHARGE DEPENDENT FLOW AND FRACTURE OF NON-METALLIC SOLIDS
A. R. C. Westwood, J. J. Mills, and R. D. Huntington Jan. 1976 12 p refs Proposed for presentation to the 7th Intern. Congress on Rheology, August 1976
(Grant NSF APR-73-07787)
(PB-252464/3; NSF/RA-760022) Avail: NTIS HC A02/MF A01 CSCL 07D

The chemomechanical effect is thought to be a consequence of chemisorption induced changes in the electronic structure of the surficial regions of the solid. Such changes influence the ease of generating or moving kinks on dislocations near the surface, and hence dislocation mobility, and so, in turn, hardness. This and other possible mechanisms are described. The use of chemomechanical phenomena to facilitate flow and fracture dependent industrial processes such as machining, drilling and grinding, and for controlling friction and wear, is briefly discussed. GRA

N77-10209# National Bureau of Standards, Washington, D.C. Center for Fire Research.
BACK-UP REPORT FOR THE PROPOSED STANDARD FOR THE FLAMMABILITY OF GENERAL WEARING APPAREL Final Report
E. Braun, V. B. Cobble, S. Helzer, J. F. Krasny, and R. D. Peacock Jun. 1976 51 p refs Prepared in cooperation with Consumer Product Safety Comm., Washington, D. C.
(PB-255446/7; NBSIR-76-1072) Avail: NTIS HC A04/MF A01 CSCL 11E

Reasons for the choices of experimental arrangement for the flammability test and the choices of pass-fail criteria are discussed. The proposed standard specifies that fabrics which transfer little heat to the inside of the specimens could be used in all garments but would have to be used in garments which cover most of the body and/or fit loosely. Fabrics which transfer larger amounts of heat, and thus have larger injury potential, could be used in garments with normal or tight fit such as most present-day shirts, slacks, etc. If such fabrics ignite in 1/2 second or less, they would be excluded from use in garments. GRA

N77-10210# Lockheed Aircraft Corp., Marietta, Ga.
FULL TEMPERATURE RANGE PROTECTIVE SYSTEM FOR FASTENER AREAS OF CARRIER-BASED NAVAL AIRCRAFT Summary Report, 1 Jan. 1974 - 31 Dec. 1975
R. N. Miller, G. G. Seeliger, and W. A. Boggs Feb. 1976 107 p refs
(Contract N00019-74-C-0267)
(AD-A024523; LG76ER0029) Avail: NTIS HC A06/MF A01 CSCL 11/3

Results are presented for a program to develop a full temperature range (-65 to 325 F) protective systems for carrier-based aircraft. Selected primers, intermediate coatings, and topcoats were subjected to screening tests. The best coating systems were applied to aluminum and titanium specimens representative of aircraft joints. After five cycles of a simulated flight spectrum, the specimens were checked for coating defects, corrosion, and coating adhesion. The most effective coating

combinations were three-layer systems composed of a MIL-P-23377 epoxy-polyamide primer, an aliphatic linear polyurethane topcoat, and intermediate coats of elastomeric polyurethane or inhibited polysulfide. These, plus an additional system with an inhibited polysulfide primer and polyurethane topcoat, were applied to A-7 carrier-based Navy aircraft during 1975. Plans were made for the periodic inspection of the test aircraft over a span of 3 years. Navy C-130 Aircraft BUNO 149787 with experimental coating systems on the upper center wing was given a two-year inspection in August 1975. Except for minor scratches, all systems were in excellent condition. Author (GRA)

N77-10211# National Bureau of Standards, Washington, D.C.
FRICTIONAL PROPERTIES OF DILUTE BLOCK-COPOLYMER SOLUTIONS AND HOMOPOLYMER SOLUTIONS. APPLICATION TO MOLECULAR WEIGHT DETERMINATION Final Report
Francis W. Wang 1976 6 p refs Repr. from Macromolecules, v. 9, Jan. - Feb. 1976 p 97-101
(PB-255193/5) Avail: NTIS HC A02/MF A01 CSCL 07C

An equation for the translational diffusion coefficient of block copolymers in dilute solution has been obtained by modifying Zimm's equation for homopolymers to take into account the existence of dissimilar segments in block copolymers. Illustrative calculations for homopolymers and block copolymers have been made and the results for homopolymers have been compared with experiments and with the calculations of Yamakawa and Fujii. A procedure has been proposed to determine the molecular weight of a block copolymer from measurements of its limiting viscosity number and its sedimentation coefficient or translational diffusion coefficient. GRA

N77-10212# Rutgers Univ., New Brunswick, N.J. Dept. of Mechanics and Materials Science.
AN X-RAY STUDY OF POLYETHYLENE AT PRESSURES UP TO 14000 KG/SQ CM AT 298 DEGREES K
T. P. Sham, B. A. Newman, and K. D. Pae 31 Mar. 1976 33 p refs Submitted for publication
(Contract N00014-75-C-0540; NR Proj. 356-564)
(AD-A024559; TR-4) Avail: NTIS HC A03/MF A01 CSCL 20/2

The diamond piston-anvil method was used to make X-ray wide angle diffraction studies of polyethylene at 298 K and at pressures up to 14,000 kg/sq cm. The data obtained were compared with the results of a study by Ito and Marui, and their observations (which were carried out at pressures up to 3000 kg/sq cm) were essentially confirmed. However, our data revealed that the linear-compressibility in the (110) and (200) directions did not vary with pressure in a linear fashion over the entire range. By ignoring strains in the chain direction, the volumetric strains as a function of pressure were calculated, and the data agreed well with the equation of state derived by Pastine for the crystalline phase of polyethylene. A value for the Gruneisen constant gamma sub o at atmospheric pressure and 298 K was calculated and the pressure range reported. GRA

N77-10233*# Utah Univ., Salt Lake City.
FRACTURE IN MACRO-MOLECULES
K. L. DeVries *In* NASA. Langley Res. Center Adv. in Eng. Sci., Vol. 1 1976 p 27-35 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10234*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
STRUCTURE-PROPERTY RELATIONSHIPS IN BLOCK COPOLYMERS
James E. McGrath *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 37-49 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N77-10213* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CASTING PROPELLANT IN ROCKET ENGINE Patent
John E. Roach (Thiokol Chemical Corp., Bristol, Pa.) and Stuart C. Froehling, inventors (to NASA) (Thiokol Chemical Corp., Bristol, Pa.) Issued 5 Oct. 1976 8 p Filed 14 Nov. 1962 Sponsored by NASA
(NASA-Case-LAR-11995-1; US-Patent-3,983,780; US-Patent-Appl-SN-238826; US-Patent-Class-86-1R; US-Patent-Class-102-99; US-Patent-Class-264-3R) Avail: US Patent Office CSCL 21I

A method is described for casting a solid propellant in the casing of a rocket engine having a continuous wall with a single opening which is formed by leaves of a material which melt at a temperature of the propellant and with curved edges concentric to the curvature of the spherical casing. The leaves are inserted into the spherical casing through the opening forming a core having a greater width than the width of the single opening and with curved peripheral edges. The cast propellant forms a solid mass and then heated to melt the leaves and provide a central opening with radial projecting flutes.
Official Gazette of the U.S. Patent Office

N77-10214*# General Dynamics/Convair, San Diego, Calif.
CENTAUR PROPELLANT THERMAL CONDITIONING STUDY
M. H. Blatt, R. L. Pleasant, and R. C. Erickson Jul. 1976 131 p refs
(Contract NAS3-19693)
(NASA-CR-135032; CASD-NAS-76-026) Avail: NTIS HC A07/MF A01 CSCL 21I

A wicking investigation revealed that passive thermal conditioning was feasible and provided considerable weight advantage over active systems using throttled vent fluid in a Centaur D-1s launch vehicle. Experimental wicking correlations were obtained using empirical revisions to the analytical flow model. Thermal subcoolers were evaluated parametrically as a function of tank pressure and NPSP. Results showed that the RL10 category I engine was the best candidate for boost pump replacement and the option showing the lowest weight penalty employed passively cooled acquisition devices, thermal subcoolers, dry ducts between burns and pumping of subcooler coolant back into the tank. A mixing correlation was identified for sizing the thermodynamic vent system mixer. Worst case mixing requirements were determined by surveying Centaur D-1T, D-1S, IUS, and space tug vehicles. Vent system sizing was based upon worst case requirements. Thermodynamic vent system/mixer weights were determined for each vehicle. Author

N77-10215# Technological Lab. RVO-TNO, Rijswijk (Netherlands).
THE ANALYSIS OF ALPHA, GAMMA AND DELTA HMX IN BETA HMX. A LITERATURE SURVEY [DE ANALYSE VAN ALPHA-, GAMMA- EN DELTA-OKTOGEEN IN BETA-OKTOGEEN. LITERATUUROVERZICHT]
H. L. Barreveld 30 Sep. 1975 19 p refs In DUTCH; ENGLISH summary
(Contract A70/KL/057)
(TL-1975-17; TDCK-66918) Avail: NTIS HC A02/MF A01

A literature survey of HMX (1, 3, 5, 7 - tetranitro - 2, 4, 6, 8 - octahydro - 1, 3, 5, 7 - tetrazocine) is given. A disadvantage associated with the use of HMX (also called octogen) as a military explosive is the possibility of transition of the stable beta-HMX into other polymorphs. There are certain hazard aspects connected with these transitions. The literature study comprises the properties of HMX polymorphs, the preparation of HMX polymorphs, and the qualitative and quantitative analyses of these polymorphs using infrared spectroscopic, X-ray diffraction, differential thermal analysis, and microscopic techniques. ESA

N77-10216# Technological Lab. RVO-TNO, Rijswijk (Netherlands).
IMPROVEMENT OF THE ACCEPTANCE AND SURVEILLANCE CONTROL OF NITRATE ESTER PROPELLANTS. PART 5: INVESTIGATION INTO THE INFLUENCE OF THE TYPE OF STABILIZER ON THE STABILITY OF NITRATE ESTER PROPELLANTS
E. Jilderda 18 Sep. 1975 10 p ref
(TL-1975-19; TDCK-67016) Avail: NTIS HC A02/MF A01

Within the framework of the investigation into the determination of the influence of the type of stabilizer on the stability of nitrate ester propellants, the stability of six propellants with different types of stabilizer was investigated with the aid of the heat generation test. Only small differences between the propellants with regard to storage safety and ballistic stability were found. A propellant was investigated with a stabilizer content equal to one of the six propellants mentioned above, but with a lower nitrogen content. The safe storage life of this propellant at 368 K was found to be considerably shorter than that of the propellant with the higher nitrogen content. The results of the classical tests appeared to be different from the results of the heat generation test. Author (ESA)

N77-10217# Institut fuer Chemie der Treib- und Explosivstoffe, Pfinztal (West Germany).
SYNTHESIS OF LEAD SALICYLATES [DARSTELLUNG VON BLEISALICYLATEN]
W. Engel and H. Heinisch 27 Aug. 1975 29 p refs In GERMAN
(ICT-1/75) Avail: NTIS HC A03/MF A01

The synthesis of lead salicylates to be used as combustion moderators in double base rocket propellants is discussed. The lead monosalicylate was prepared from lead oxide and salicylic acid, from lead nitrate and sodium salicylate using sodium bicarbonate as a buffer, and from lead disalicylate by splitting off salicylic acid. Lead disalicylate monohydrate was prepared from lead oxide and salicylic acid or from lead nitrate and sodium salicylate. Drying of the lead disalicylate monohydrate produced the waterfree product without any problem. ESA

N77-10218# Institut fuer Chemie der Treib- und Explosivstoffe, Pfinztal (West Germany).
DEPENDENCE OF THE COMBUSTION RATE OF SOLID PROPELLANTS ON THE INITIAL TEMPERATURE [ABHAENGIGKEIT DER ABBRANDGESCHWINDIGKEIT VON DER ANFANGSTEMPERATUR BEI FESTTREIBSTOFFEN]
N. Eisenreich 31 Dec. 1975 34 p refs In GERMAN
(ICT-5/75) Avail: NTIS HC A03/MF A01

The influence of the ignition temperature on the combustion rate of solid rocket propellants was studied. Theoretical investigations on combustion rate are reviewed and the experiments and their results are detailed: adaptation of the measurement values to the law of Crow and Grimshaw, surface temperature and temperature gradient, and plateau and mesa pressure range for double base propellants. The results are discussed with emphasis on the temperature dependence of the combustion rate and the combustion mechanism. It is shown that, despite the availability of measurements at three initial temperatures only, important information on the initial temperature/combustion rate relationship has been obtained. ESA

N77-10219# European Space Agency, Paris (France).
PROPELLANT SELECTION FOR RAMJETS WITH SOLID FUEL
Robert H. Schmucker et al Sep. 1976 31 p refs Transl. into ENGLISH of "Zur Treibstoffauswahl bei Staustrahltriebwerken mit Festbrennstoff", DFVLR, Lampoldshausen, West Ger. Report DLR-FB-76-18, 11 Mar. 1976 Original German report available from DFVLR, Cologne DM 14,20
(ESA-TT-317; DLR-FB-76-18) Avail: NTIS HC A03/MF A01

Ramjet propulsion using solid propellant for post-boost acceleration of missiles exhibits several favorable properties, brought about by heterogeneous combustion. A simplified theory for calculating the performance of possible propellants is presented; they are classified with respect to maximum fuel-specific impulse. The optimal choice of fuel, from a system standpoint, must consider volume constraints and defines the requirements for motor geometry. Author (ESA)

N77-10220# Environmental Protection Agency, Research Triangle Park, N.C. Monitoring and Data Analysis Div.
NATIONAL EMISSIONS DATA SYSTEMS (NEDS) FUEL USE REPORT, 1973 Final Report
Apr. 1976 130 p
(PB-253908/8; EPA-450/2-76-004) Avail: NTIS HC A07/MF A01 CSCL 21D

Annual estimates of total consumption of major fuels such as coal, fuel oil, natural gas, gasoline, and diesel fuel are summarized. Estimates of the consumption of a number of other comparatively minor fuels are also included. The data are distributed according to major categories of air pollutant emissions sources and are reported for the nation as a whole and for individual states, territories, and the District of Columbia. GRA

N77-10221# Southwest Research Inst., San Antonio, Tex.
PROTOCOL TO CHARACTERIZE GASEOUS EMISSIONS AS A FUNCTION OF FUEL AND ADDITIVE COMPOSITION Final Report, Feb. 1974 - Jun. 1975
Harry E. Dietzmann Sep. 1975 132 p refs
(Contract EPA-68-02-1275)
(PB-253363/6; EPA-600/2-75-048) Avail: NTIS HC A07/MF A01 CSCL 21D

An engine dynamometer test schedule for additive effects is validated. Previous problems with vehicle to engine dynamometer comparability were solved by the use of a Clayton power absorption unit and a fixed flywheel as an inertia simulator. Thus, adequate road simulation was achieved. Numerous analytical techniques were developed including analysis for SO2, H2S, COS, methyl and ethyl mercaptan, ammonia, N,N-dimethylnitrosamine, hydrocarbon distribution, and sulfate. No additive derived products were found in the study of two commercial additive packages with either catalyst or non-catalyst engine configurations. The mileage accumulation schedule used resulted in overly high rates of accumulation of intake manifold deposits for both additive and base fuels. GRA

N77-10222# National Academy of Sciences - National Research Council, Washington, D.C. Committee on Toxicology.
FUELS AND FUEL ADDITIVES FOR HIGHWAY VEHICLES AND THEIR COMBUSTION PRODUCTS. GUIDE TO EVALUATION OF THEIR POTENTIAL EFFECTS ON HEALTH Final Report
1976 52 p refs
(Contract EPA-68-01-0432)
(PB-254088/8; NAS/ACT/P-755) Avail: NTIS HC A04/MF A01 CSCL 06T

Problems associated with testing fuels, fuel additives and their combustion products for potential public health problems are discussed. Conclusions follow: (1) Initial evaluation of safety of a new fuel-additive combination should include comparison between a standard fuel and the new combination. (2) Biologic methods suggested for initial evaluation should be sensitive to the possibility that known human health effects from such sources may increase or diminish. (3) Separate considerations and more extensive research on most metal-containing additives should be required because of their persistence in the environment and their tendency to accumulate in the body. (4) All methods will need careful validation and inter-laboratory studies. (5) Interpreting results of studies on combustion products is difficult at best; decisions should be made by informed scientists. (6) Appropriate epidemiologic and analytic studies should be conducted whenever new fuel-additive combinations are introduced. GRA

N77-10223# Georgia Inst. of Tech., Atlanta.
COMPLEX METAL HYDRIDES. HIGH ENERGY FUEL COMPONENTS FOR SOLID PROPELLANT ROCKET MOTORS Annual Report, 1 Jan. - 31 Dec. 1975
Eugene C. Ashby 31 Dec. 1975 125 p refs
(Contract N00014-67-A-0159-0005; NR Proj. 093-050)
(AD-A023783) Avail: NTIS HC A06 MF A01 CSCL 07/2

During this report period work has continued on the preparation and structure elucidation of simple and complex metal hydrides of the main group elements. Four papers have appeared in Inorganic Chemistry Journal concerning work carried out on the ONR program. Projects completed during the past year are (1) The Direct Synthesis of Polyiminoalanes and, (2) Preparation of New Complex Metal Hydrides of Magnesium and Zinc.

Mg(ZnH3)2 and MgZnH4. Projects in progress involve the preparation of RMgH and RMg2H3 compounds and the attempted preparation of Mg(CuH2)2, MgCuH3, LiMgH3, Li2MgH4 and ate complexes such as LiMgRH2. GRA

N77-10224# Federal Energy Administration, Washington, D.C.
NATIONAL PETROLEUM PRODUCT SUPPLY AND DEMAND, 1976 - 1978
Christopher B. Alt May 1976 249 p refs
(PB-254969/9; FEA/B-76/281) Avail: NTIS HC A11/MF A01 CSCL 21D

A documentation of the short term petroleum product supply and demand forecasting methodology is presented. Four petroleum product supply and demand forecasts are presented for the period 1976 through 1978. The four forecasts consist of a base case and three alternative cases: (1) composite low demand, (2) composite high demand, and (3) low domestic supply. The four cases differ with respect to the following: (1) projections of economic growth, (2) impact of natural gas curtailments on petroleum demand, (3) nomal or abnormal weather, (4) implementation of the Energy Policy and Conservation Act of 1975, (5) estimates of conservation savings, and (6) projections of domestic crude oil production. GRA

N77-10225# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
EFFECTS OF EXPOSURE TO MONOMETHYLHYDRAZINE AND 1,1-DIMETHYLHYDRAZINE ON THE IMMUNOLOGICAL RESPONSIVENESS OF GUINEA PIGS Final Report, Jun. 1974 - Sep. 1975
Michael K. Pangburn Feb. 1976 13 p refs
(AF Proj. 6302)
(AD-A024165; AMRL-TR-76-7) Avail: NTIS HC A02/MF A01 CSCL 21/9

The humoral immune response of guinea pigs was measured by determining serum antibody titers to bovine serum albumin. Cell mediated immunity was tested in vivo by evaluating the delayed hypersensitivity to tuberculin. Three compounds were tested. One, 6-mercaptopurine (6MP), was a known immunosuppressive drug. Its administration resulted in significantly depressed humoral and cellular responses, demonstrating that these methods could be used to evaluate immunosuppression in routine toxicity testing. Exposure to the two toxic rocket propellants monomethylhydrazine and 1,1-dimethylhydrazine resulted in a similar but less pronounced decrease in immune responsiveness.
Author (GRA)

N77-10226# Systems Science and Software, La Jolla, Calif.
BRLSC: AN ADVANCED EULERIAN CODE FOR PREDICTING SHAPED CHARGES, VOLUME 1 Final Report, 1 Jan. - 31 Dec. 1970
M. L. Gittings Dec. 1975 156 p refs
(Contract DAAD05-70-C-0275)
(AD-A023962; Rept-3SR-642-Vol-1; BRL-CR-279-Vol-1) Avail: NTIS HC A08/MF A01 CSCL 19/1

The BRLSC code is a modified version of the HELP code developed for the purpose of predicting phenomena associated with the performance of shaped charges. During the process of modifying HELP to enable it to handle shaped charge problems, a number of additions and changes were introduced. The resulting differences between HELP and BRLSC fall into two basic categories. The first category includes the necessary additions to enable the code to generate shaped charge problems, treat explosives, simulate a slip surface between the liner and the explosive, and insure realistic jet formation. These additions were specifically required by the shaped charge application. The second category consists of changes made to improve the way in which free surface cells are handled, to allow the thin liner to move through the grid without becoming distorted, to increase the reliability and stability of calculations, and to decrease the cost of running problems. As the result of these additions and changes, most of the subroutines in BRLSC have been changed substantially from the original HELP version. However, since most of the logic involved is similar to that employed in HELP, users familiar with HELP should have no difficulities with BRLSC.
Author (GRA)

N77-10227# Picatinny Arsenal, Dover, N.J.
FUNCTIONING TIMES AND SIMULTANEITY OF HOT BRIDGEWIRE DETONATORS XM100 AND T20E1
Thomas McKimm Apr. 1976 30 p refs
(AD-A024034; PA-TR-4858) Avail: NTIS HC A03/MF A01 CSCL 19/1

To determine the suitability of conventional hot bridgewire (HBW) detonators for use in multiple point-initiation warheads requiring precise firing times, detonators XM100 and T20E1 were tested using a capacitive discharge firing circuit with moderate voltage levels (100 volts maximum). The T20E1 conventional HBW detonator can approach a functioning time of 2 microseconds with a simultaneity of approximately 0.4 microseconds. For conventional munitions with limited power sources, this HBW should be adequate. Author (GRA)

N77-10228# Rheinische Braunkohlenwerke A.G., Cologne (West Germany).
GASIFICATION OF COAL AND ITS FUTURE ASPECTS REGARDING THE USE OF HEAT FROM HIGH-TEMPERATURE NUCLEAR REACTORS
H. Teggers 25 Aug. 1975 19 p refs Presented at the Intern. Seminar for Heat and Mass Transfer, Dubrovnik, Yugoslavia, 25 Aug. 1975
(INIS-MF-1965) MF available from INIS Section, International Atomic Energy Agency, P. O. box 590 A-1011, Vienna, Austria

Recent demands to convert coal to synthetic natural gas or synthetic gas are considered in terms of increased prices for oil and natural gas. The economic feasibility of gasification of coal by using heat from gas cooled high temperature nuclear reactors is also discussed. The possibilities and problems of this process are shown and compared with conventional processes. ERA

N77-10344*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYDROGEN-FUELED SUBSONIC AIRCRAFT: A PERSPECTIVE
Robert D. Witcofski *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1265-1278 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 21D

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N77-10229* National Aeronautics and Space Administration. Pasadena Office, Calif.
CRYOSTAT SYSTEM FOR TEMPERATURES ON THE ORDER OF 2 DEG K OR LESS Patent
Charles G. Miller (JPL) and James B. Stephens, inventors (to NASA) (JPL) Issued 5 Oct. 1976 9 p Filed 24 Jul. 1975 Supersedes N75-29277 (13 - 20, p 2507) Sponsored by NASA
(NASA-Case-NPO-13459-1; US-Patent-3,983,714;
US-Patent-Appl-SN-598967; US-Patent-Class-62-217;
US-Patent-Class-62-514JT) Avail: US Patent Office CSCL 20L

A cryostat system for cooling a device to a temperature on the order of 2 K or less includes a dewar, in which helium, in other than the superfluid state, is stored. Helium flows from the dewar through a heat exchanger tube and a restrictor tube, which controls the helium flow rate, into the cavity of a heat exchanger, to whose outer wall the device to be cooled is attached. A pressure regulator value controls the pressure in the cavity to be very low. As the helium exits the restrictor tube into the cavity, due to low pressure cavity, it becomes an aerosol mixture of helium gas and superfluid helium droplets at the desired temperature. The latter form a thin layer or film of superfluid helium on the inner side of the heat exchanger wall and thereby cool the device, which is attached to the wall to the desired temperature. Official Gazette of the U.S. Patent Office

N77-10230*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCES IN ENGINEERING SCIENCE, VOLUME 1

1976 360 p refs Presented at the 13th Ann. Meeting of The Soc. of Eng. Sci. 1-3 Nov. 1976, Hampton, Va.; sponsored by JIAFS and George Washington Univ. 1 Vol.
(NASA-CP-2001-Vol-1) Avail: NTIS HC A16/MF A01 CSCL 13M

Proceedings from a conference on engineering advances are presented, including materials science, fracture mechanics, and impact and vibration testing. The tensile strength and moisture transport of laminates are also discussed. For individual titles, see N77-10231 through N77-10264.

N77-10231*# Carnegie-Mellon Univ., Pittsburgh, Pa. Center for the Joining of Materials.
MICROSCOPIC ASPECTS OF INTERFACIAL REACTIONS IN DIFFUSION BONDING PROCESSES c26
Michael P. Shearer and Charles L. Bauer *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 3-35 refs Sponsored by NSF (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

Microscopic aspects of interfacial reactions are discussed, such as interdiffusion, formation of intermetallic phases, generation and annihilation of lattice defects, effect of temperature, grain size, etc., which normally occur in diffusion bonding processes. Relationships between properties and microstructure in thin film couples are examined utilizing a unique combination of contact resistance measurements and characterization by transmission electron microscopy. Author

N77-10232*# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.
MACROSCOPIC ASPECTS OF INTERFACIAL REACTIONS c26
R. W. Heckel *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 15-35 refs Sponsored by NSF (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

The extent of interdiffusion and formation of new phases is determined by the constitution diagram of the alloy system, the interdiffusion coefficients of the phases present, and the thermal conditions (temperature and time) associated with the bonding process and/or subsequent use of the bonded structure. In many instance, the kinetics of interdiffusion and phase formation can be predicted from known parameters using numerical methods and computer techniques. Predictions are compared with experimentally determined parameters for a variety of metallurgical alloy systems. Author

N77-10233*# Utah Univ., Salt Lake City.
FRACTURE IN MACRO-MOLECULES c27
K. L. DeVries *In* NASA. Langley Res. Center Adv. in Eng. Sci., Vol. 1 1976 p 27-35 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

Techniques available for the observation of molecular bond rupture during fracture of polymers are briefly outlined. Additional pertinent information can also often be inferred from microscopic and macroscopic measures. Author

N77-10234*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
STRUCTURE-PROPERTY RELATIONSHIPS IN BLOCK COPOLYMERS c27
James E. McGrath *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 37-49 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

Block copolymers are a class of relatively new materials which contain long sequences of two (or more) chemically different repeat units. Unlike random copolymers, each segment may retain some properties which are characteristic of its homopolymer. It is well known that most physical blends of two different homopolymers are incompatible on a macro-scale. By contrast most block copolymers display only a microphase (eg. 100-200 A domains) separation. Complete separation is restricted because of a loss in configurational entropy. The latter is due to presence of chemical bond(s) between the segments. Novel physical properties can be obtained because it is possible to prepare any desired combination of rubber-like, glassy, or crystalline blocks. The architecture and sequential arrangement of the segments can strongly influence mechanical behavior. Author

N77-10235*# Michigan Univ., Dearborn.
A CRITICAL REVIEW OF THE EFFECTS OF MEAN AND COMBINED STRESSES ON FATIGUE LIMIT OF METALS c26
R. E. Little *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 51-65 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

The effects of mean and combined stresses on the fatigue limit of metals are critically reexamined. Data are presented which contradict the widely used fatigue limit analyses. Author

N77-10236*# West Virginia Univ., Morgantown.
INFLUENCE OF ACOUSTICS IN SEPARATION PROCESSES c71
Harold V. Fairbanks *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 61-65 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

The effects of introducing high energy acoustics into various filtering and drying systems were studied. With very slow velocity filtration systems, it was found that the introduction of acoustics could substantially increase the flow rate and also aided in the coagulation of the particulates before reaching the filter media. In the drying of temperature sensitive powders, the rate was increased by the introduction of acoustics. The acoustic frequency used was 20 kHz with power levels up to 3 watts per square centimeter. Author

N77-10237*# Aerospace Corp., El Segundo, Calif.
MICROMECHANICS OF SLIP BANDS ON A FREE SURFACE c76
S. R. Lin and T. H. Lin (Univ. Calif., Los Angeles) *In* NASA. Langley Res. Center Adv. in Eng. Sci., Vol. 1 1976 p 67-75 refs (For primary document see N77-10230 01-31)
(Grant NSF ENG-74-03809)
Avail: NTIS HC A02/MF A01

A micromechanics analysis for the formation and propagation of slip bands on the free surface of a polycrystal under monotonic loading is presented. For the growth of slip bands, the analysis satisfies the conditions of both equilibrium and displacement continuity, as well as the relation between slip and the resolved shear stress throughout the polycrystal. Numerical calculations show how the microstress field causes the concentration of plastic deformation in discrete sliding bands and give results which are in good qualitative agreement with known slip band observations on aluminum single crystals. Author

N77-10238*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
ON ONSAGERS PRINCIPLE, DISLOCATION MOTION AND HYDROGEN EMBRITTLEMENT c26
M. R. Louthan, Jr. and R. P. McNitt *In* NASA. Langley Res. Center Advan. in Eng Sci., Vol. 1 1976 p 77-84 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

Onsager's reciprocal relationships from the linear theory of irreversible thermodynamics are applied to hydrogen - dislocation interactions. Existing experimental evidence shows that dislocation motion causes localized hydrogen accumulation; thus, from the Onsager principle, localized hydrogen accumulations will affect dislocation motion and therefore the properties of metals and alloys exposed to hydrogen environments. Author

N77-10239*# Illinois Univ., Chicago.
WAVE SPEEDS AND SLOWNESS SURFACE IN ELASTIC-PLASTIC MEDIA OBEYING TRESCA'S YIELD CONDITION c39
T. C. T. Ting *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 85-102 refs (For primary document see N77-10230 01-31)
(Grant DAAG29-76-G-0121)
Avail: NTIS HC A16/MF A01

With the coordinate axes chosen along the principal axes of the stress, the plastic wave speeds c(f) and c(s) depend on the

direction of propagation, not on the stress components. The directions along which c(f) and c(s) assume the largest and smallest values are determined. A means of determining the slowness surface when the coordinate axes are not along the principal axes of stress is presented. Author

N77-10240*# Norwegian Geotechnical Inst., Oslo.
MATHEMATICAL MODELLING OF UNDRAINED CLAY BEHAVIOR **c46**
Jean-Herve Prevost and Kaare Noeg *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 95-102 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

The proposed general analytical model describes the anisotropic, elastoplastic, path-dependent, stress-strain properties of inviscid saturated clays under undrained conditions. Model parameters are determined by using results from strain-controlled simple shear tests on a saturated clay. The model's accuracy is evaluated by applying it to predict the results of other tests on the same clay, including monotonic and cyclic loading. The model explains the very anisotropic shear strength behavior observed for weak marine clays. Author

N77-10241*# Connecticut Univ., Storrs.
THEORY OF ORTHODONTIC MOTIONS **c52**
Susan Pepe, W. Dennis Pepe (Conn. General Insurance Co.), and Alvin M. Strauss (Cincinnati Univ.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 103-110 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

A general theory of orthodontic motion is developed that can be applied to determine the forces necessary to induce a given tooth to move to the predetermined desirable position. It is assumed that the natural (nonorthodontic) forces may be represented by a periodic function and the orthodontic forces may be superimposed upon the natural forces. A simple expression is derived for the applied stress. Author

N77-10242*# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
NONLINEAR EFFECTS IN THERMAL STRESS ANALYSIS OF A SOLID PROPELLANT ROCKET MOTOR **c20**
E. C. Francis, R. L. Peeters, and S. A. Murch *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 111-135 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

Direct characterization procedures were used to determine the relaxation modulus as a function of time, temperature, and state of strain. Using the quasi-elastic method of linearviscoelasticity, these properties were employed in a finite element computer code to analyze a thick-walled, nonlinear viscoelastic cylinder in the state of plane strain bonded to a thin (but stiff) elastic casing and subjected to slow thermal cooling. The viscoelastic solution is then expressed as a sequence of elastic finite element solutions. The strain-dependent character of the relaxation modulus is included by replacing the single relaxation curve used in the linear viscoelastic theory by a family of relaxation functions obtained at various strain levels. These functions may be regarded as a collection of stress histories or responses to specific loads (in this case, step strains) with which the cooldown solution is made to agree by iterations on the modulus and strain level. Author

N77-10243*# Joint Inst. for Advancement of Flight Sciences, Washington, D. C.
COMPUTER SIMULATION OF SCREW DISLOCATION IN ALUMINUM **c26**
Donald M. Esterling *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 137-146 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

The atomic structure in a [110] screw dislocation core for aluminum is obtained by computer simulation. The lattice statics technique is employed since it entails no artificially imposed elastic boundary around the defect. The interatomic potential has no adjustable parameters and was derived from pseudopotential theory. The resulting atomic displacements were allowed to relax in all three dimensions. Author

N77-10244*# Michigan Univ., Ann Arbor.
MOISTURE TRANSPORT IN COMPOSITES **c24**
George S. Springer *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 147-156 refs Sponsored by AFML (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

The moisture distribution and moisture content of composite materials exposed to humid air or to water are discussed. Expressions are presented for estimating the weight gain of both single and multilayered composites when the moisture content and the temperature of the environment are constant. The parameters needed for solving problems in the time varying environmental conditions are specified, and a numerical approach for the solution of such problems is indicated. Author

N77-10245*# Washington Univ., Seattle.
A HIGH ORDER THEORY FOR UNIFORM AND LAMINATED PLATES **c24**
King H. Lo, Richard M. Christensen (Univ. of Calif.), and Edward M. Wu (Univ. of Calif.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol 1 1976 p 157-166 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

A theory of plate deformation is derived which accounts for the effects of transverse shear deformation, transverse normal strain, and a nonlinear distribution of the in-plane displacements with respect to the thickness coordinate. The theory is compared with lower order plate theories through application to a particular problem involving a plate acted upon by a sinusoidal surface pressure. Comparison is also made with exact elasticity solution of this problem. It is found that when the ratio of the characteristic length of the load pattern to the plate thickness is of the order of unity, lower order theories are inadequate and the present high order theory is required to give meaningful results. Results are given for the bending of symmetric cross-ply and angle-ply laminates. Comparison with exact elasticity solutions indicates that the present plate theory is sufficiently accurate for predicting the behavior of thick laminates. Author

N77-10246*# Cornell Univ., Ithaca, N.Y.
STOCHASTIC MODELS FOR THE TENSILE STRENGTH, FATIGUE **c24**
S. Leigh Phoenix *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 167-181 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

The time-to-failure of a single fiber is modeled as a functional of the fiber load history and reasonable forms for this functional are proposed. Earlier models by Daniels and Coleman are shown to be special cases of the proposed model and apparent disparities in their behavior are discussed. Techniques are presented for determining analytically the asymptotic distributions of the tensile strength and time-to-failure for bundles of a large number of fibers. For smaller bundles, exact results are far too cumbersome to be of use so that efficient Monte Carlo simulation procedures are proposed. Author

N77-10247*# Utah Univ., Salt Lake City.
PROGRESSIVE FAILURE OF NOTCHED COMPOSITE LAMINATES USING FINITE ELEMENTS **c24**
Ralph J. Nuismer and Gary E. Brown (Air Force Academy) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 183-192 refs Sponsored by Utah Univ. Research Fund (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

An incremental, nonlinear, finite element program capable of tracing the damage that occurs in a notched laminated composite, before ultimate failure takes place, is described. Computer predictions for the ultimate failure load and failure modes are compared to experimental results for two laminates containing holes and loaded in uniaxial tension. The comparison is quite favorable. Author

N77-10248*# Dayton Univ. Research Inst., Ohio.
RESIDUAL STRESSES IN POLYMER MATRIX COMPOSITE LAMINATES **c24**
H. Thomas Hahn *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 193-204 refs (For primary document

see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

Residual stresses in composites are induced during fabrication and by environmental exposure. The theory formulated can describe the shrinkage commonly observed after a thermal expansion test. Comparison between the analysis and experimental data for laminates of various material systems indicates that the residual stress-free temperature can be lower than the curing temperature, depending on the curing process. Effects of residual stresses on ply failure including the acoustic emission characteristics are discussed. Author

N77-10249*# Lehigh Univ., Bethlehem, Pa.
INFLUENCE OF SPECIMEN BOUNDARY ON THE DYNAMIC STRESS INTENSITY FACTOR **c39**
E. P. Chen and G. C. Sih *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 205-214 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

The problem to be considered is the sudden appearance of a flaw or crack in a strip of material of finite height subjected to tensile loading. Stress waves are generated within the strip and are reflected from boundary to boundary. Of interest is the maximum value of the dynamic stress intensity factor at a given instance of time as the strip height to crack length ratio is varied. Author

N77-10250*# Georgia Inst. of Tech., Atlanta.
FINITE-ELEMENT ANALYSIS OF DYNAMIC FRACTURE **c39**
J. A. Aberson, J. M. Anderson, and W. W. King *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 215-225 refs (For primary document see N77-10230 01-31)
(Contract F08635-76-C-0136)
Avail: NTIS HC A16/MF A01

Applications of the finite element method to the two dimensional elastodynamics of cracked structures are presented. Stress intensity factors are computed for two problems involving stationary cracks. The first serves as a vehicle for discussing lumped-mass and consistent-mass characterizations of inertia. In the second problem, the behavior of a photoelastic dynamic tear test specimen is determined for the time prior to crack propagation. Some results of a finite element simulation of rapid crack propagation in an infinite body are discussed. Author

N77-10251*# State Univ. of New York, Stony Brook.
APPLICATION OF A NOVEL FINITE DIFFERENCE METHOD TO DYNAMIC CRACK PROBLEMS **c39**
Yung M. Chen and Mark L. Wilkins (Lawrence Livermore Lab) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 227-238 refs (For primary document see N77-10230 01-31)
(Contract W-7405-eng-48; Grant DAAG29-76-G-0197)
Avail: NTIS HC A16/MF A01

A versatile finite difference method (HEMP and HEMP 3D computer programs) was developed originally for solving dynamic problems in continuum mechanics. It was extended to analyze the stress field around cracks in a solid with finite geometry subjected to dynamic loads and to simulate numerically the dynamic fracture phenomena with success. This method is an explicit finite difference method applied to the Lagrangian formulation of the equations of continuum mechanics in two and three space dimensions and time. The calculational grid moves with the material and in this way it gives a more detailed description of the physics of the problem than the Eulerian formulation. Author

N77-10252*# Kentucky Univ., Lexington.
RAPID INTERFACE FLAW EXTENSION WITH FRICTION **c39**
L. M. Brock *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 239-246 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

An idealized two-dimensional example of rapid interface flow extension is described. Initially undisturbed dissimilar isotropic, homogeneous, linearly elastic half-spaces are perfectly bonded along the interface $y = 0$. Quantities associated with the half-space $\leq$ or $=$ to 0 are denoted by the prime superscript or the subscripts 3 or 4 while those in $y >$ or $=$ to 0 carry the subscripts 1 or 2. At time $t' = 0$ adjacent material points at $x = 0$, $y = +$ or -0 are forced apart horizontally with a constant relative velocity delta v. This results in a zone of bond failure which extends symmetrically along the interface at a constant rate c. The newly created flaw surfaces are in sliding contact resisted by Coulomb friction. The friction coefficient is gamma. Author

N77-10253*# Iowa State Univ. of Science and Technology, Ames.
DYNAMIC DUCTILE FRACTURE OF A CENTRAL CRACK **c39**
Y. M. Tsai *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 247-256 refs (For primary document see N77-10230 01-31)
(Grant NSF ENG-74-08147)
Avail: NTIS HC A16/MF A01

A central crack, symmetrically growing at a constant speed in a two dimensional ductile material subject to uniform tension at infinity, is investigated using the integral transform methods. The crack is assumed to be the Dugdale crack, and the finite stress condition at the crack tip is satisfied during the propagation of the crack. Exact expressions of solution are obtained for the finite stress condition at the crack tip, the crack shape, the crack opening displacement, and the energy release rate. All those expressions are written as the product of explicit dimensional quantities and a nondimensional dynamic correction function. The expressions reduce to the associated static results when the crack speed tends to zero, and the nondimensional dynamic correction functions were calculated for various values of the parameter involved. Author

N77-10254*# George Washington Univ., Washington, D.C.
A STUDY OF THE EFFECT OF SUBCRITICAL CRACK GROWTH ON THE GEOMETRY DEPENDENCE ON NONLINEAR FRACTURE TOUGHNESS PARAMETERS **c39**
D. L. Jones, P. K. Poulose, and H. Liebowitx *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 257-266 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

The effect of subcritical crack growth on the geometry dependence of nonlinear fracture toughness parameters was studied by comparing the toughness values for different specimen geometries at the onset of subcritical crack growth and at the initiation of unstable crack propagation. Center-cracked thin sheet specimens of 2024-T3 and 7075-T6 aluminum alloys were tested by varying the specimen length L, width w, and crack length-to-width ratio c/w. When the onset of unstable crack propagation was selected as the critical point, the nonlinear energy toughness and the R curve toughness increased with increasing w and decreasing L and c/w. However, when the onset of subcritical crack growth was taken as the critical point, energy toughness and the linear toughness values were independent of these geometrical variables. Author

N77-10255*# Georgia Inst. of Tech., Atlanta.
ON A 3-D SINGULARITY ELEMENT FOR COMPUTATION OF COMBINED MODE STRESS INTENSITIES **c39**
Satya N. Atluri and K. Kathiresan *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol 1 1976 p 267-274 refs (For primary document see N77-10230 01-31)
(Grants AF-AFOSR-2667-74; NSF ENG-74-213469)
Avail: NTIS HC A16/MF A01

A special three-dimensional singularity element is developed for the computation of combined modes 1, 2, and 3 stress intensity factors, which vary along an arbitrarily curved crack front in three dimensional linear elastic fracture problems. The finite element method is based on a displacement-hybrid finite element model, based on a modified variational principle of potential energy, with arbitrary element interior displacements, interelement boundary displacements, and element boundary tractions as variables. The special crack-front element used in this analysis contains the square root singularity in strains and stresses, where the stress-intensity factors K(1), K(2), and K(3) are quadratically variable along the crack front and are solved directly along with the unknown nodal displacements. Author

N77-10256*# Banaras Hindu Univ., Varanasi (India).
INFLUENCE OF A CIRCULAR HOLE UNDER UNIFORM NORMAL PRESSURE ON THE STRESSES AROUND A LINE CRACK IN AN INFINITE PLATE **c39**
Ram Narayan and R. S. Mishra *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 275-282 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

Based on the two dimensional theory of elasticity and by the use of Muskhelishvili's technique, the influence of a circular hole, under uniform normal pressure, on the stresses around a line crack in an infinite plate subjected to tension is discussed. Numerical calculations were carried out, and the variation of the crack tip stress intensity factor due to the geometry was clarified. Author

N77-10257*# Lehigh Univ., Bethlehem, Pa.
THE EFFECT OF SEVERAL INTACT OR BROKEN STRINGERS OF THE STRESS INTENSITY FACTOR IN A CRACKED SHEET **c39**
K. Arin *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol 1 1976 p 283-290 refs (For primary document see N77-10230 01-31)
(Grant NsG-1178)
Avail: NTIS HC A16/MF A01

The stringers which are continuously attached to the plate and placed perpendicular to the crack may be partially debonded due to high stress concentrations. Since the stringers may even break under excessive loading conditions, both intact and broken stringers are considered to investigate the effect of rupture. The continuity of displacements along the bond lines leads to an integral equation which is solved to give the shear stress distribution in the adhesive and the stress intensity factors at the crack tips. Author

N77-10258*# Lehigh Univ., Bethlehem, Pa.
ON THE PROBLEM OF STRESS SINGULARITIES IN BONDED ORTHOTROPIC MATERIALS **c39**
F. Erdogan and F. Delale *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol 1 1976 p 291-300 refs (For primary document see N77-10230 01-31)
(Grant NGR-39-007-011)
Avail: NTIS HC A16/MF A01

The problem of stress singularities at the leading edge of a crack lying in the neighborhood of a bimaterial interface in bonded orthotropic materials is considered. The main objective is to study the effect of material orthotropy on the singular behavior of the stress state when the crack touches or intersects the interface. The results indicate that, due to the large number of material constants involved, in orthotropic materials, the power of stress singularity as well as the stress intensity factor can be considerably different than that found in the isotropic materials with the same stiffness ratio perpendicular to the crack. Author

N77-10259*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
HIGHER-ORDER EFFECTS OF INITIAL DEFORMATION ON THE VIBRATIONS OF CRYSTAL PLATES **c76**
Xanthippi Markenscoff *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 301-308 refs Submitted for publication (For primary document see N77-10230 01-31)
(Grant NSF ENG-75-11875)
Avail: NTIS HC A16/MF A01

A system of plate equations for the thickness-shear and flexural vibrations superposed on large initial deflection due to bending is derived; in the stress-strain relations, the terms associated with the fourth-order elastic stiffness coefficients are retained. An explicit formula for the change in the fundamental cut-off thickness shear frequency is obtained, and the effects of the terms associated with the fourth-order constants appear to be significant for large gradients of the rotation angles. Author

N77-10260*# Cincinnati Univ., Ohio.
BIODYNAMICS OF DEFORMABLE HUMAN BODY MOTION **c52**
Alvin M. Strauss and Ronald L. Huston *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 309-318 refs (For primary document see N77-10230 01-31)
(Grants NSF ENG-75-21037; NSF ENG-75-06619)
Avail: NTIS HC A16/MF A01

The objective is to construct a framework wherein the various models of human biomaterials fit in order to describe the biodynamic response of the human body. The behavior of the human body in various situations, from low frequency, low amplitude vibrations to impact loadings in automobile and aircraft crashes, is very complicated with respect to all aspects of the problem: materials, geometry and dynamics. The materials problem is the primary concern, but the materials problem is intimately connected with geometry and dynamics. Author

N77-10261*# Naval Academy, Annapolis, Md.
IMPACT TENSILE TESTING OF WIRES **c37**
T. H. Dawson *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 319-326 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

The test consists of fixing one end of a wire specimen and allowing a threaded falling weight to strike the other. Assuming the dynamic stress in the wire to be a function only of its strain, energy considerations show for negligible wire inertia effects that the governing dynamic stress-strain law can be determined directly from impact energy vs. wire elongation data. Theoretical calculations are presented which show negligible wire inertia effects for ratios of wire mass to striking mass of the order of .01 or less. The test method is applied to soft copper wires and the dynamic stress-strain curve so determined is found to be about 30 percent higher than the corresponding static curve. Author

N77-10262*# Southern Illinois Univ., Carbondale.
NUMERICAL DETERMINATION OF THE TRANSMISSIBILITY CHARACTERISTICS OF A SQUEEZE FILM DAMPED FORCED VIBRATION SYSTEM **c37**
Michael A. Sutton (Babcock and Wilcox Co.) and Philip K. Davis *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 327-338 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

Numerical solutions of the governing equations of motion of a liquid squeeze film damped forced vibration system were carried out to examine the feasibility of using a liquid squeeze film to cushion and protect large structures, such as buildings, located in areas of high seismic activity. The mathematical model used was that for a single degree of freedom squeeze film damped spring mass system. The input disturbance was simulated by curve fitting actual seismic data with an eleventh order Lagranging polynomial technique. Only the normal component of the seismic input was considered. The nonlinear, nonhomogeneous governing differential equation of motion was solved numerically to determine the transmissibility over a wide range of physical parameters using a fourth-order Runge-Kutta technique. It is determined that a liquid squeeze film used as a damping agent in a spring-mass system can significantly reduce the response amplitude for a seismic input disturbance. Author

N77-10263*# Utah State Univ., Logan.
A MODEL STUDY OF LANDING MAT SUBJECTED TO C-5A LOADINGS **c39**
P. T. Blotter, F. W. Kiefer, and V. T. Christiansen *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 339-348 refs (For primary document see N77-10230 01-31)
(Contract F29601-73-C-0131)
Avail: NTIS HC A16/MF A01

The 1.22 x 1.37 m mat runway in the standard brick pattern with transverse hinged joints is more stable and less susceptible to a buckling failure than the 0.60 x 2.74 m mat runway. Use of tension anchors appears to be a feasible means of controlling longitudinal displacement of the runway and potential runway buckling. Anchors appear to be a practical means to reduce maintenance on mat runways. The 1.22 x 1.37 m mat in the alternate brick pattern or the 90 deg rotated standard brick pattern forms a dynamically more stable runway with a high resistance to buckling failure. The runway in these patterns is much stiffer and longitudinal movement was less than for the standard brick pattern. The model 1.22 x 1.37 m alternate brick

pattern runway was difficult to assemble and extremely difficult to take apart. Author

N77-10264*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
ROCK FAILURE ANALYSIS BY COMBINED THERMAL WEAKENING AND WATER JET IMPACT **c46**
Adnan H. Nayfeh *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 349-360 refs (For primary document see N77-10230 01-31)
(Grants NSF GI-39224; NSF ENG-75-20850)
Avail: NTIS HC A16/MF A01

The influence of preheating on the initiation of fracture in rocks subjected to the impingement of a continuous water jet is studied. Preheating the rock is assumed to degrade its mechanical properties and strength in accordance with existing experimental data. The water jet is assumed to place a quasi-static loading on the surface of the rock. The loading is approximated by elementary functions which permit analytic computation of the induced stresses in a rock half-space. The resulting stresses are subsequently coupled with the Griffith criteria for tensile failure to estimate the change, due to heating, in the critical stagnation pressure and velocity of the water jet required to cause failure in the rock. Author

N77-10265*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCES IN ENGINEERING SCIENCE, VOLUME 2
1976 457 p refs Presented at the 13th Ann. Meeting of Soc. of Eng. Sci., Hampton, Va., 1-3 Nov. 1976, sponsored by JIAFS and George Washington Univ. 4 Vol.
(NASA-CP-2001-Vol-2) Avail: NTIS HC A20/MF A01 CSCL 13M

Papers are presented dealing with structural dynamics; structural synthesis; and the nonlinear analysis of structures, structural members, and composite structures and materials. Applications of mathematics and computer science are included. For individual titles, see N77-10266 through N77-10304.

N77-10266*# Illinois Univ., Chicago.
ON THE STABILITY OF A CLASS OF IMPLICIT ALGORITHMS FOR NONLINEAR STRUCTURAL DYNAMICS **c39**
Ted Belytschko *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 385-391 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

Stability in energy for the Newmark beta-family of time integration operators for nonlinear material problems is examined. It is shown that the necessary and sufficient conditions for unconditional stability are equivalent to those predicted by Fourier methods for linear problems. Author

N77-10267*# Texas Univ., Austin.
A REVIEW OF SUBSTRUCTURE COUPLING METHODS FOR DYNAMIC ANALYSIS **c39**
Roy R. Craig, Jr. and Ching-Jone Chang *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 393-408 refs (For primary document see N77-10265 01-31)
(Grant NsG-1268)
Avail: NTIS HC A20/MF A01

The state of the art is assessed in substructure coupling for dynamic analysis. A general formulation, which permits all previously described methods to be characterized by a few constituent matrices, is developed. Limited results comparing the accuracy of various methods are presented. Author

N77-10268*# Akron Univ., Ohio.
CORIOLIS EFFECTS ON NONLINEAR OSCILLATIONS OF ROTATING CYLINDERS AND RINGS **c39**
Joseph Padovan *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 409-416 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

The effects which moderately large deflections have on the frequency spectrum of rotating rings and cylinders are considered. To develop the requisite solution, a variationally constrained version of the Lindstedt-Poincare procedure is employed. Based on the solution developed, in addition to considering the effects of displacement induced nonlinearity, the role of Coriolis forces is also given special consideration. Author

N77-10269*# California Univ., Livermore. Lawrence Livermore Lab.
ON THE EXPLICIT FINITE ELEMENT FORMULATION OF THE DYNAMIC CONTACT PROBLEM OF HYPERELASTIC MEMBRANES **c39**
J. O. Hallquist and W. W. Feng *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 417-424 refs (For primary document see N77-10265 01-31)
(Contract W-7405-eng-48)
Avail: NTIS HC A20/MF A01

Contact-impact problems involving finite deformation axisymmetric membranes are solved by the finite element method with explicit time integration. The formulation of the membrane element and the contact constraint conditions are discussed. The hyperelastic, compressible Blatz and Ko material is used to model the material properties of the membrane. Two example problems are presented. Author

N77-10270*# College of William and Mary, Williamsburg, Va.
FREE VIBRATIONS OF LAMINATED COMPOSITE ELLIPTIC PLATES **c39**
C. M. Andersen and Ahmed K. Noor (George Washington Univ.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 425-438 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

The free vibrations are studied of laminated anisotropic elliptic plates with clamped edges. The analytical formulation is based on a Mindlin-Reissner type plate theory with the effects of transverse shear deformation, rotary inertia, and bending-extensional coupling included. The frequencies and mode shapes are obtained by using the Rayleigh-Ritz technique in conjunction with Hamilton's principle. A computerized symbolic integration approach is used to develop analytic expressions for the stiffness and mass coefficients and is shown to be particularly useful in evaluating the derivatives of the eigenvalues with respect to certain geometric and material parameters. Numerical results are presented for the case of angle-ply composite plates with skew-symmetric lamination. Author

N77-10271*# Massachusetts Inst. of Tech., Cambridge.
SOME DYNAMIC PROBLEMS OF ROTATING WINDMILL SYSTEMS **c39**
John Dugundji *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 439-447 refs (For primary document see N77-10265 01-31)
(Grant NSF AER-75-00826)
Avail: NTIS HC A20/MF A01

The basic whirl stability of a rotating windmill on a flexible tower is reviewed. Effects of unbalance, gravity force, gyroscopic moments, and aerodynamics are discussed. Some experimental results on a small model windmill are given. Author

N77-10272*# Argonne National Lab., Ill.
DYNAMIC INELASTIC RESPONSE OF THICK SHELLS USING ENDOCHRONIC THEORY AND THE METHOD OF NEARCHARACTERISTICS **c39**
Hsuan-Chi Lin *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 449-458 refs Sponsored by ERDA (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

The endochronic theory of plasticity originated by Valanis was applied to study the axially symmetric motion of circular cylindrical thick shells subjected to an arbitrary pressure transient applied at its inner surface. The constitutive equations for the thick shells were obtained. The governing equations are solved by means of the nearcharacteristics method. Author

N77-10273*# New Mexico State Univ., University Park.
VIBRATIONS AND STRESSES IN LAYERED ANISOTROPIC CYLINDERS **c39**
G. P. Mulholland and B. P. Gupta (Fluor Engineers and Constructors, Inc.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 459-472 refs (For primary document see

N77-10265 01-31)
Avail: NTIS HC A20/MF A01

An equation describing the radial displacement in a k layered anisotropic cylinder was obtained. The cylinders are initially unstressed but are subjected to either a time dependent normal stress or a displacement at the external boundaries of the laminate. The solution is obtained by utilizing the Vodicka orthogonalization technique. Numerical examples are given to illustrate the procedure. Author

N77-10274*# Tennessee Technological Univ., Cookeville.
INCREMENTAL ANALYSIS OF LARGE ELASTIC DEFORMATION OF A ROTATING CYLINDER **c39**
George R. Buchanan *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 473-480 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

The effect of finite deformation upon a rotating, orthotropic cylinder was investigated using a general incremental theory. The incremental equations of motion are developed using the variational principle. The governing equations are derived using the principle of virtual work for a body with initial stress. The governing equations are reduced to those for the title problem and a numerical solution is obtained using finite difference approximations. Since the problem is defined in terms of one independent space coordinate, the finite difference grid can be modified as the incremental deformation occurs without serious numerical difficulties. The nonlinear problem is solved incrementally by totaling a series of linear solutions. Author

N77-10275*# Technical Univ. of Istanbul (Turkey).
VARIATIONAL THEOREMS FOR SUPERIMPOSED MOTIONS IN ELASTICITY, WITH APPLICATION TO BEAMS **c39**
M. Cengiz Doekmeci *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 481-490 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

Variational theorems are presented for a theory of small motions superimposed on large static deformations and governing equations for prestressed beams on the basis of 3-D theory of elastodynamics. First, the principle of virtual work is modified through Friedrichs's transformation so as to describe the initial stress problem of elastodynamics. Next, the modified principle together with a chosen displacement field is used to derive a set of 1-D macroscopic governing equations of prestressed beams. The resulting equations describe all the types of superimposed motions in elastic beams, and they include all the effects of transverse shear and normal strains, and the rotatory inertia. The instability of the governing equations is discussed briefly. Author

N77-10276*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESPONSE OF LONG, FLEXIBLE CANTILEVER BEAMS APPLIED ROOT MOTIONS **c39**
Robert W. Fralich *In its* Advan. in Eng. Sci., Vol. 2 1976 p 491-499 ref (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01 CSCL 13M

Results are presented for an analysis of the response of long, flexible cantilever beams to applied root rotational accelerations. Maximum values of deformation, slope, bending moment, and shear are found as a function of magnitude and duration of acceleration input. Effects of tip mass and its eccentricity and rotatory inertia on the response are also investigated. It is shown that flexible beams can withstand large root accelerations provided the period of applied acceleration can be kept small relative to the beam fundamental period. Author

N77-10277*# Illinois Univ., Chicago.
OPTIMAL DESIGN AGAINST COLLAPSE AFTER BUCKLING **c39**
E. F. Masur *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 501-508 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

After buckling, statically indeterminate trusses, beams, and other strictly symmetric structures may collapse under loads which reach limiting magnitudes. Optimal design is discussed for prescribed values of these collapse loads. Author

N77-10278*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
OPTIMUM VIBRATING BEAMS WITH STRESS AND DEFLECTION CONSTRAINTS **c39**
Manohar P. Kamat *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 509-519 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

The fundamental frequency of vibration of an Euler-Bernoulli or a Timoshenko beam of a specified constant volume is maximized subject to the constraint that under a prescribed loading the maximum stress or maximum deflection at any point along the beam axis will not exceed a specified value. In contrast with the inequality constraint which controls the minimum cross-section, the present inequality constraints lead to more meaningful designs. The inequality constraint on stresses is as easily implemented as the minimum cross-section constraint but the inequality constraint on deflection uses a treatment which is an extension of the matrix partitioning technique of prescribing displacements in finite element analysis. Author

N77-10279*# Washington Univ., St. Louis, Mo.
AN OPTIMAL STRUCTURAL DESIGN ALGORITHM USING OPTIMALITY CRITERIA **c39**
John E. Taylor (Michigan Univ.) and Mark P. Rossow *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 521-530 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

An algorithm for optimal design is given which incorporates several of the desirable features of both mathematical programming and optimality criteria, while avoiding some of the undesirable features. The algorithm proceeds by approaching the optimal solution through the solutions of an associated set of constrained optimal design problems. The solutions of the constrained problems are recognized at each stage through the application of optimality criteria based on energy concepts. Two examples are described in which the optimal member size and layout of a truss is predicted, given the joint locations and loads. Author

N77-10280*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
A RAYLEIGH-RITZ APPROACH TO THE SYNTHESIS OF LARGE STRUCTURES WITH ROTATING FLEXIBLE COMPONENTS **c39**
L. Meirovitch and A. L. Hale *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 531-542 refs (For primary document see N77-10265 01-31)
(Grant NsG-1114)
Avail: NTIS HC A20/MF A01

The equations of motion for large structures with rotating flexible components are derived by regarding the structure as an assemblage of substructures. Based on a stationarity principle for rotating structures, it is shown that each continuous or discrete substructure can be simulated by a suitable set of admissible functions or admissible vectors. This substructure synthesis approach provides a rational basis for truncating the number of degrees of freedom both of each substructure and of the assembled structure. Author

N77-10281*# Battelle Columbus Labs., Ohio.
THE STAGING SYSTEM: DISPLAY AND EDIT MODULE **c39**
Ed Edwards and Leo Bernier (AFFDL) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 543-553 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

The Display and Edit (D and E) Module described is one of six major modules being developed for the STAGING (STructural Analysis through Generalized INteractive Graphics) System. Several remarks are included concerning the computer environment and the architecture of the data base. The utility of this module is emphasized. Author

N77-10282*# Texas Univ., Austin. Inst. for Computational Mechanics.

SOME CONVERGENCE PROPERTIES OF FINITE ELEMENT APPROXIMATIONS OF PROBLEMS IN NONLINEAR ELASTICITY WITH MULTI-VALUED SOLUTIONS **c64**
J. T. Oden *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 555-562 ref (For primary document see N77-10265 01-31)
(Grant NSF ENG-75-07846)
Avail: NTIS HC A20/MF A01

Some results of studies of convergence and accuracy of finite element approximations of certain nonlinear problems encountered in finite elasticity are presented. A general technique for obtaining error bounds is also described together with an existence theorem. Numerical results obtained by solving a representative problem are also included. Author

N77-10283*# Toledo Univ., Ohio.
ELASTO-PLASTIC IMPACT OF HEMISPHERICAL SHELL IMPACTING ON HARD RIGID SPHERE **c37**
D. D. Raftopoulos and A. L. Spicer (Gen. Motors Corp.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 563-573 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

An analysis of plastic stress waves for cylindrical metallic projectile in impact is extended to an analysis of a hemispherical shell suffereing plastic deformation during the process of impact. It is assumed that the hemispherical shell with a prescribed launch velocity impinges a fixed rigid sphere of diameter equal to the internal diameter of the shell. The dynamic biaxial state of stress present in the shell during deformation is investigated. The analysis is valuable for studying the state of stress during large plastic deformation of a hemispherical shell. Author

N77-10284*# Tennessee Technological Univ., Cookeville.
LARGE DEFLECTIONS OF SHALLOW CONICAL MEMBRANE **c39**
Wen-Hu Chang and John Peddieson, Jr. *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 575-584 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

Large deflections of a shallow elastic conical membrane fixed at the outer edge and loaded by either uniform or hydrostatic pressure are investigated. The overning equations were solved by the method of matched asymptotic expansions and by a finite difference method. Agreement between the two methods was excellent for the small values of the perturbation parameter. Author

N77-10285*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
A PLANE STRAIN ANALYSIS OF THE BLUNTED CRACK TIP USING SMALL STRAIN DEFORMATION PLASTICITY THEORY **c39**
J. J. McGowan and C. W. Smith *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 585-594 refs (For primary document see N77-10265 01-31)
(Grant NSF GK-39922)
Avail: NTIS HC A20/MF A01

A deformation plasticity analysis of the tip region of a blunted crack in plane strain is presented. The power hardening material is incompressible both elastically and plastically, in order to simulate behavior of a stress freezing material above critical temperature. Stress and displacement fields surrounding the crack tip are presented. The results indicate that the maximum stress seen at the crack tip is indeed limited and is determined by the tensile properties; however, the scale over which the stresses act is dependent on the loading. Comparisons are good between the forward crack tip displacement and micro-fractographic measurments of stretch zones observed in plane strain fracture toughness tests. Author

N77-10286*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GAUSSIAN IDEAL IMPULSIVE LOADING OF RIGID VISCOPLASTIC PLATES **c39**
Robert J. Hayduk *In its* Advan. in Eng. Sci., Vol. 2 1976 p 595-616 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01 CSCL 13M

The response of a thin, rigid, viscoplastic plate subjected to a spatially axisymmetric Gaussian ideal impulse loading was studied analytically. The Gaussian ideal impulse distribution instantaneously imparts a Gaussian initial velocity distribution to the plate, except at the fixed boundary. The plate deforms with monotonically increasing deflections until the initial dynamic energy is completely dissipated in plastic work. The simply supported plate of uniform thickness obeys the von Mises yield criterion and a generalized constitutive equation for rigid, viscoplastic materials. For the small deflection bending response of the plate, neglecting the transverse shear stress in the yield condition and rotary inertia in the equations of dynamic equilibrium, the governing system of equations is essentially nonlinear. A proportional loading technique, known to give excellent approximations of the exact solution for the uniform load case, was used to linearize the problem and obtain analytical solution in the form of eigenvalue expansions. The linearized governing equations required the knowledge of the collapse load of the corresponding static problem. Author

N77-10287*# Virginia Univ., Charlottesville. Dept. of Applied Mathematics and Computer Science.
RECENT ADVANCES IN SHELL THEORY **c39**
James G. Simmonds *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 617-626 refs (For primary document see N77-10265 01-31)
(Grant NSF MPS-73-08650)
Avail: NTIS HC A20/MF A01

The results reviewed are divided into two categories: those that relate two-dimensional shell theory to three-dimensional elasticity theory and those concerned with shell theory per se. In the second category results for general elastic systems that carry over, by specialization or analogy, to shells and results that are unique to shell theory itself are considered. Author

N77-10288*# Argonne National Lab., Ill.
FLUID-PLASTICITY OF THIN CYLINDRICAL SHELLS **c39**
Dusan Krajcinovic *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 627-637 refs Sponsored by ERDA (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

Dynamic plastic response of a thin cylindrical shell, immersed in a potential fluid initially at rest and subjected to internal pressure pulse of arbitrary shape and duration, is examined. The shell is assumed to respond as a rigid-perfectly plastic material while the fluid is taken as inviscid and incompressible. The fluid back pressure is incorporated into the equation of motion of the shell as an added mass term. Since arbitrary pulses can be reduced to equivalent rectangular pulses, the equation of motion is solved only for a rectangular pulse. The influence of the fluid in reducing the final plastic deformation is demonstrated by a numerical example. Author

N77-10289*# Kentucky Univ., Lexington.
THERMAL STRESSES IN A SPHERICAL PRESSURE VESSEL HAVING TEMPERATURE-DEPENDENT, TRANSVERSELY ISOTROPIC, ELASTIC PROPERTIES **c39**
T. R. Tauchert *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 639-651 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A30/MF A01

Rayleigh-Ritz and modified Rayleigh-Ritz procedures are used to construct approximate solutions for the response of a thick-walled sphere to uniform pressure loads and an arbitrary radial temperature distribution. The thermoelastic properties of the sphere are assumed to be transversely isotropic and nonhomogeneous; variations in the elastic stiffness and thermal expansion coefficients are taken to be an arbitrary function of the radial coordinate and temperature. Numerical examples are presented which illustrate the effect of the temperature-dependence upon the thermal stress field. A comparison of the approximate solutions with a finite element analysis indicates that Ritz methods offer a simple, efficient, and relatively accurate approach to the problem. Author

N77-10290*# General Motors Research Labs., Warren, Mich.
ANALYSIS OF PANEL DENT RESISTANCE **c37**
Chi-Mou Ni *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 653-663 refs (For primary document see

N77-10265 01-31)
Avail: NTIS HC A20/MF A01

An analytical technique for elastic-plastic deformation of panels was developed, which is employed to analyze the denting mechanisms of panels resulting from point projectile impacts and impulsive loadings. The correlations of analytical results with the experimental measurements are considered quite satisfactory. The effect of elastic springback on the dent resistance analysis is found to be very significant for the panel (122 cm x 60.9 cm x 0.076 cm) subjected to a point projectile impact at 16.45 m/sec. While the amount of springback decreases as the loading speed increases, the effect due to the strain rate hardening of material, such as low carbon steel, becomes more dominant and is demonstrated in the analysis of dent resistance of a rectangular steel plate impulsively loaded. Author

N77-10291*# Borg-Warner Corp., Chicago, Ill. Roy C. Ingersoll Research Center.
NEUTRAL ELASTIC DEFORMATIONS c39
Metin M. Durum *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 665-670 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

Elastic bodies or systems may not require external energy for certain finite and continuous deformations. Conditions providing these kinds of effortless, or neutral, deformations are discussed. Author

N77-10292*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY ON THE FORCED VIBRATION OF A TIMOSHENKO BEAM c39
Bucur Zainea *In its* Advan. in Eng. Sci., Vol. 2 1976 p 671-685 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01 CSCL 13M

By using Galerkin's variational method an approximate solution is developed for a system of two differential equations with linear partial derivatives of the second order. This system of differential equations corresponds to the physical model, known in the literature as the Timoshenko Beam. The results obtained are applied to two particular cases representing respectively: the case of a beam with a rectangular section, with a constant height and a basis with a linear variation; and the case of a beam with a constant basis and a height with cubic variation. Author

N77-10293*# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
ENVIRONMENTAL EFFECTS ON POLYMERIC MATRIX COMPOSITES c24
J. M. Whitney and G. E. Husman *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 687-696 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

Current epoxy resins utilized in high performance structural composites absorb moisture from high humidity environments. Such moisture absorption causes plasticization of the resin to occur with concurrent swelling and lowering of the glass transition temperature. Similar effects are observed in composites. Data are presented showing the effects of absorbed moisture on Hercules AS/3501-5 graphite/epoxy composites. Prediction of moisture content and distribution in composites, along with reduction in mechanical properties, are discussed. Author

N77-10294*# Texas Univ., Austin.
STRESS INTENSITY AT A CRACK BETWEEN BONDED DISSIMILAR MATERIALS c39
Morris Stern and Chen-Chin Hong *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 699-709 refs Sponsored by NSF (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

The contour integral method is extended to general boundary value problems involving imperfect bonding of dissimilar materials. The loading and restraints are shown to have a significant effect on the stress intensity. Example problems are presented to illustrate the results. Author

N77-10295*# Georgia Inst. of Tech., Atlanta.
STRESS CONCENTRATION FACTORS AROUND A CIRCULAR HOLE IN LAMINATED COMPOSITES c39
C. E. S. Ueng *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 711-720 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

Stress concentration factors around a circular hole in a composite laminate are determined. The specific case investigated is a four layer (-45/45/45/-45 degs) graphite epoxy laminate. The factors are determined experimentally by means of electrical resistance strain gages, and analytically by using a hybrid finite element analysis. Author

N77-10296*# Drexel Univ., Philadelphia, Pa. Dept. of Mechanical Engineering and Mechanics.
TRANSFER MATRIX APPROACH TO LAYERED SYSTEMS WITH AXIAL SYMMETRY c24
Leon Y. Bahar *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 721-729 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

The stress and displacement distribution in a layered medium is found by means of transfer matrices. The surface loading exhibits axial symmetry, and each layer is of infinite extent in the horizontal direction, of constant depth, and is considered to be linearly elastic, homogeneous, and isotropic. The method developed has the built-in advantage of enforcing interface continuity conditions automatically. Its application to layered composites shows the flexibility with which it predicts the local as well as the global response of the medium. Author

N77-10297*# Stevens Inst. of Tech., Hoboken, N.J.
APPLIED GROUP THEORY APPLICATIONS IN THE ENGINEERING (PHYSICAL, CHEMICAL, AND MEDICAL), BIOLOGICAL, SOCIAL, AND BEHAVIORAL SCIENCES AND IN THE FINE ARTS c80
S. F. Borg *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 731-740 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

A generalized applied group theory is developed, and it is shown that phenomena from a number of diverse disciplines may be included under the umbrella of a single theoretical formulation based upon the concept of a group consistent with the usual definition of this term. Author

N77-10298*# South Carolina Univ., Columbia.
RESPONSE OF LINEAR DYNAMIC SYSTEMS WITH RANDOM COEFFICIENTS c62
John Dickerson *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 741-745 (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

Numerous models of physical systems contain parameters whose values are not known exactly. The physical and mathematical complexities arising in the prediction of the statistical behavior of such systems are discussed. Although the discussions are far from providing a satisfactory solution to such problems, they perhaps, by utilization of simple examples, will create a greater awareness of the statistical effect of random parameters. Author

N77-10299*# Christopher Newport Coll., Va.
APPLICATIONS OF CATASTROPHE THEORY IN MECHANICS c62
Martin Buoncristiani and George R. Webb *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 747-756 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

A method, using Thom's classification of catastrophes, is described for the analysis of stability of systems whose static behavior is derived from a potential function. Examination of the stability of singular points of potential functions serves to illustrate the nature of the elementary catastrophes which also arise in nonconservative dynamical systems as well as in the static case of potential theory. Author

N77-10300*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STABILITY OF NEUTRAL EQUATIONS WITH CONSTANT TIME DELAYS **c64**
L. Keith Barker and John L. Whitesides (George Washington Univ.) *In its* Advan. in Eng. Sci., Vol. 2 1976 p 757-768 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01 CSCL 12A

A method was developed for determining the stability of a scalar neutral equation with constant coefficients and constant time delays. A neutral equation is basically a differential equation in which the highest derivative appears both with and without a time delay. Time delays may appear also in the lower derivatives or the independent variable itself. The method is easily implemented, and an illustrative example is presented. Author

N77-10301*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CUBIC SPLINE REFLECTANCE ESTIMATES USING THE VIKING LANDER CAMERA MULTISPECTRAL DATA **c74**
Stephen K. Park and Friedrich O. Huck *In its* Advan. in Eng. Sci., Vol. 2 1976 p 769-778 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01 CSCL 20F

A technique was formulated for constructing spectral reflectance estimates from multispectral data obtained with the Viking lander cameras. The output of each channel was expressed as a linear function of the unknown spectral reflectance producing a set of linear equations which were used to determine the coefficients in a representation of the spectral reflectance estimate as a natural cubic spline. The technique was used to produce spectral reflectance estimates for a variety of actual and hypothetical spectral reflectances. Author

N77-10302*# Texas Univ., Austin.
DATA MANAGEMENT IN ENGINEERING **c81**
J. C. Browne *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 779-789 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

An introduction to computer based data management is presented with an orientation toward the needs of engineering application. The characteristics and structure of data management systems are discussed. A link to familiar engineering applications of computing is established through a discussion of data structure and data access procedures. An example data management system for a hypothetical engineering application is presented. Author

N77-10303*# Michigan Univ., Ann Arbor.
TOOLS FOR COMPUTER GRAPHICS APPLICATIONS **c60**
R. L. Phillips *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 791-803 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

Extensive research in computer graphics has produced a collection of basic algorithms and procedures whose utility spans many disciplines. These tools are described in terms of their fundamental aspects, implementations, applications, and availability. Programs which are discussed include basic data plotting, curve smoothing, and depiction of three dimensional surfaces. As an aid to potential users of these tools, particular attention is given to discussing their availability and, where applicable, their cost. Author

N77-10304*# Massachusetts Univ., Amherst.
COMPUTER SYSTEMS: WHAT THE FUTURE HOLDS **c62**
Harold S. Stone *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 805-817 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

Developement of computer architecture is discussed in terms of the proliferation of the microprocessor, the utility of the medium-scale computer, and the sheer computational power of the large-scale machine. Changes in new applications brought about because of ever lowering costs, smaller sizes, and faster switching times are included. Author

N77-10305*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCES IN ENGINEERING SCIENCE, VOLUME 3
1976 464 p refs Presented at the 13th Ann. Meeting of the Soc. of Eng. Sci., Hampton, Va., 1-3 Nov. 1976; sponsored by JIAFS and George Washington Univ. 4 Vol.
(NASA-CP-2001-Vol-3) Avail: NTIS HC A20/MF A01 CSCL 13M

Papers concerning acoustics, environmental modeling, and energy technology are presented. For individual titles, see N77-10306 through N77-10344.

N77-10306*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
SOUND PROPAGATION THROUGH NONUNIFORM DUCTS **c71**
Ali Hasan Nayfeh *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 821-833 refs (For primary document see N77-10305 01-31)
(Contract NAS1-13884)
Avail: NTIS HC A20/MF A01

Methods of determining the transmission and attenuation of sound propagating in nonuniform ducts with and without mean flows are discussed. The approaches reviewed include purely numerical techniques, quasi-one-dimensional approximations, solutions for slowly varying cross sections, solutions for weak wall undulations, approximation of the duct by a series of stepped uniform cross sections, variational methods and solutions for the mode envelopes. Author

N77-10307*# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
NONLINEAR PERIODIC WAVES **c71**
Lu Ting *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 837-850 refs (For primary document see N77-10305 01-31)
(Grant NsG-1291)
Avail: NTIS HC A20/MF A01

Systematic perturbation procedures for the analysis of nonlinear problems are reviewed. The cases when the multiplicity of an eigenvalue is finite or infinite are treated for self-sustained and forced oscillations. The possibility of the formation of shock waves is discussed. Applications to acoustic problems are presented. Author

N77-10308*# Stanford Univ., Calif.
FEATURES OF SOUND PROPAGATION THROUGH AND STABILITY OF A FINITE SHEAR LAYER **c71**
S. P. Koutsoyannis *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol 3 1976 p 851-860 refs Sponsored by NASA (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

The plane wave propagation, the stability and the rectangular duct mode problems of a compressible inviscid linearly sheared parallel, but otherwise homogeneous flow, are shown to be governed by Whittaker's equation. The exact solutions for the perturbation quantities are essentially Whittaker M-functions. A number of known results are obtained as limiting cases of exact solutions. For the compressible finite thickness shear layer it is shown that no resonances and no critical angles exist for all Mach numbers, frequencies and shear layer velocity profile slopes except in the singular case of the vortex sheet. Author

N77-10309*# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
EFFECTS OF HIGH SUBSONIC FLOW ON SOUND PROPAGATION IN A VARIABLE-AREA DUCT **c71**
A. J. Callegari and M. K. Myers (George Washington Univ., Washington, D. C.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 861-872 refs Sponsored by NASA (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

The propagation of sound in a converging-diverging duct containing a quasi-one-dimensional steady flow with a high subsonic throat Mach number was studied. The behavior of linearized acoustic theory at the throat of the duct was shown to be singular. This singularity implies that linearized acoustic theory is invalid. The explicit singular behavior was determined

and used to sketch the development (by the method of matched asymptotic expansions) of a nonlinear theory for sound propagation in a sonic throat region. Author

N77-10310*# General Electric Co., Philadelphia, Pa.
EFFECTS OF MEAN FLOW ON DUCT MODE OPTIMUM SUPPRESSION RATES **c71**
Robert E. Kraft and William R. Wells (Cincinnati Univ.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 873-882 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

The nature of the solution to the convected acoustic wave equation and associated boundary conditions for rectangular ducts containing uniform mean flow is examined in terms of the complex mapping between the wall admittance and characteristic mode eigenvalues. It is shown that the Cremer optimum suppression criteria must be modified to account for the effects of flow below certain critical values of the nondimensional frequency parameter of duct height divided by sound wavelength. The implications of these results on the design of low frequency suppressors are considered. Author

N77-10311*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INLET NOISE SUPPRESSOR DESIGN METHOD BASED UPON THE DISTRIBUTION OF ACOUSTIC POWER WITH MODE CUTOFF RATIO **c71**
Edward J. Rice *In its* Advan. in Eng. Sci., Vol. 3 1976 p 883-894 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 20A

A liner design for noise suppressors with outer wall treatment such as in an engine inlet is presented which potentially circumvents the problems of resolution in modal measurement. The method is based on the fact that the modal optimum impedance and the maximum possible sound power attenuation at this optimum can be expressed as functions of cutoff ratio alone. Modes with similar cutoff ratios propagate similarly in the duct and in addition propagate similarly to the far field. Thus there is no need to determine the acoustic power carried by these modes individually, and they can be grouped together as one entity. With the optimum impedance and maximum attenuation specified as functions of cutoff ratio, the off-optimum liner performance can be estimated using an approximate attenuation equation. Author

N77-10312*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ORIFICE RESISTANCE FOR EJECTION INTO A GRAZING FLOW **c34**
Kenneth J. Baumeister *In its* Advan. in Eng. Sci., Vol. 3 1976 p 895-905 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 20D

To explain the decrease in orifice resistance with the addition of grazing flow, the flow from an orifice was modeled by using an inviscid analysis which is valid when the orifice flow total pressure is nearly the same as the free stream grazing flow total pressure. For steady outflow from an orifice into a grazing flow, the orifice flow can enter the main grazing flow in an inviscid manner without generating large eddies to dissipate the kinetic energy of the jet. From the analysis, a simple closed-form solution was developed for the steady resistance for ejection from an orifice into a grazing-flow field. The calculated resistance compare favorably with data for a flow regime where the total pressure difference between the grazing flow and the orifice flow is small. Author

N77-10313*# New Jersey Inst. of Technology, Newark.
A SIMPLE SOLUTION OF SOUND TRANSMISSION THROUGH AN ELASTIC WALL TO A RECTANGULAR ENCLOSURE, INCLUDING WALL DAMPING AND AIR VISCOSITY EFFECTS **c71**
Amir N. Nahavandi, Benedict C. Sun, and W. H. Warren Ball *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 907-916 ref (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

A simple solution to the problem of the acoustical coupling between a rectangular structure, its air content, and an external noise source is presented. This solution is a mathematical expression for the normalized acoustic pressure inside the structure. Numerical results for the sound-pressure response for a specified set of parameters are also presented. Author

N77-10314*# Pennsylvania State Univ., University Park. Applied Physics Lab.
PARAMETRIC ACOUSTIC ARRAYS: A STATE OF THE ART REVIEW **c71**
Francis Hush Fenlon *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 917-932 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

Following a brief introduction to the concept of parametric acoustic interactions, the basic properties of parametric transmitting and receiving arrays are considered in the light of conceptual advances resulting from experimental and theoretical investigations that have taken place since 1963. Author

N77-10315*# Toronto Univ. (Ontario).
NON-DIMENSIONAL GROUPS IN THE DESCRIPTION OF FINITE-AMPLITUDE SOUND PROPAGATION THROUGH AEROSOLS **c71**
David S. Scott *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 933-945 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

Several parameters, which have fairly transparent physical interpretations, appear in the analytic description of finite-amplitude sound propagation through aerosols. Typically, each of these parameters characterizes, in some sense, either the sound or the aerosol. It also turns out that fairly obvious combinations of these parameters yield non-dimensional groups which, in turn, characterize the nature of the acoustic-aerosol interaction. This theme is developed in order to illustrate how a quick examination of such parameters and groups can yield information about the nature of the processes involved, without the necessity of extensive mathematical analysis. This concept is developed primarily from the viewpoint of sound propagation through aerosols, although complimentary acoustic-aerosol interaction phenomena are briefly noted. Author

N77-10316*# Tennessee Technological Univ., Cookeville.
ONE-DIMENSIONAL WAVE PROPAGATION IN PARTICULATE SUSPENSIONS **c34**
Steve G. Rochelle and John Peddieson, Jr. *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 947-954 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

One-dimensional small-amplitude wave motion in a two-phase system consisting of an inviscid gas and a cloud of suspended particles is analyzed using a continuum theory of suspensions. Laplace transform methods are used to obtain several approximate solutions. Properties of acoustic wave motion in particulate suspensions are inferred from these solutions. Author

N77-10317*# Iowa State Univ. of Science and Technology, Ames.
A CORRESPONDENCE PRINCIPLE FOR STEADY-STATE WAVE PROBLEMS **c34**
Lester W. Schmerr *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 955-962 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

A correspondence principle was developed for treating the steady state propagation of waves from sources moving along a plane surface or interface. This new principle allows one to obtain, in a unified manner, explicit solutions for any source velocity. To illustrate the correspondence principle in a particular case, the problem of a load moving at an arbitrary constant velocity along the surface of an elastic half-space is considered. Author

N77-10318*# Mississippi Univ., University.
ACOUSTICAL PROBLEMS IN HIGH ENERGY PULSED E-BEAMS LASERS **c36**
T. E. Horton and K. F. Wylie *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 963-973 refs (For primary document see N77-10305 01-31)

Avail: NTIS HC A20/MF A01

During the pulsing of high energy, CO2, electron beam lasers, a significant fraction of input energy ultimately appears as acoustical disturbances. The magnitudes of these disturbances were quantified by computer analysis. Acoustical and shock impedance data are presented on materials (Rayleigh type) which show promise in controlling acoustical disturbance in E-beam systems. Author

N77-10319*# Mississippi Univ., University.
A MICROSCOPIC DESCRIPTION OF SOUND ABSORPTION IN THE ATMOSPHERE **c71**
H. E. Bass *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol 3 1976 p 975-986 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

The various mechanisms which contribute to sound absorption in the atmosphere are identified and a technique for computing the contribution from each is presented. The similarities between sound absorption, laser fluorescence measurements, and the opto-acoustic effect are discussed. Finally, experimental sound absorption results are compared to predictions to test the microscopic energy transfer approach. Author

N77-10320*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PROPAGATION OF SOUND IN TURBULENT MEDIA **c71**
Alan R. Wenzel *In its* Advan. in Eng. Sci., Vol. 3 1976 p 987-995 refs (For primary document see N77-10305 01-31) (Contract NAS1-14101)
Avail: NTIS HC A20/MF A01 CSCL 20A

Perturbation methods commonly used to study the propagation of acoustic waves in turbulent media are reviewed. Emphasis is on those techniques which are applicable to problems involving long-range propagation in the atmosphere and ocean. Characteristic features of the various methods are illustrated by applying them to particular problems. It is shown that conventional perturbation techniques, such as the Born approximation, yield solutions which contain secular terms, and which therefore have a relatively limited range of validity. In contrast, it is found that solutions obtained with the aid of the Rytov method or the smoothing method do not contain secular terms, and consequently have a much greater range of validity. Author

N77-10321*# New Brunswick Univ., Fredericton.
NOISE PROPAGATION IN URBAN AND INDUSTRIAL AREAS **c45**
Huw G. Davies *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 997-1008 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

Noise propagation in streets and the discrepancies between theoretical analyses and field measurements are discussed. A cell-model is used to estimate the general background level of noise due to vehicular sources distributed over the urban area. Author

N77-10322*# Georgia Inst. of Tech., Atlanta.
DIFFRACTION OF SOUND BY NEARLY RIGID BARRIERS **c71**
W. James Hadden, Jr. and Allan D. Pierce *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1009-1018 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

The diffraction of sound by barriers with surfaces of large, but finite, acoustic impedance was analyzed. Idealized source-barrier-receiver configurations in which the barriers may be considered as semi-infinite wedges are discussed. Particular attention is given to situations in which the source and receiver are at large distances from the tip of the wedge. The expression for the acoustic pressure in this limiting case is compared with the results of Pierce's analysis of diffraction by a rigid wedge. An expression for the insertion loss of a finite impedance barrier is compared with insertion loss formulas which are used extensively in selecting or designing barriers for noise control. Author

N77-10323*# Georgia Inst. of Tech., Atlanta.
THE LEAKING MODE PROBLEM IN ATMOSPHERIC ACOUSTIC-GRAVITY WAVE PROPAGATION **c71**
Wayne A. Kinney and Allan D. Pierce *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1019-1030 refs Sponsored by AF (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

The problem of predicting the transient acoustic pressure pulse at long horizontal distances from large explosions in the atmosphere is examined. Account is taken of poles off the real axis and of branch line integrals in the general integral governing the transient waveform. Perturbation techniques are described for the computation of the imaginary ordinate of the poles and numerical studies are described for a model atmosphere terminated by a halfspace with c = 478 m/sec above 125 km. For frequencies less than 0.0125 rad/sec, the GR sub 1 mode, for example, is found to have a frequency dependent amplitude decay of the order of 0.0001 nepers/km. Examples of numerically synthesized transient waveforms are exhibited with and without the inclusion of leaking modes. The inclusion of leaking modes results in waveforms with a more marked beginning rather than a low frequency oscillating precursor of gradually increasing amplitude. Also, the revised computations indicate that waveforms invariably begin with a pressure rise, a result supported by other theoretical considerations and by experimental data. Author

N77-10324*# Massachusetts Inst. of Tech., Cambridge.
THE PREDICTION AND MEASUREMENT OF SOUND RADIATED BY STRUCTURES **c39**
Richard H. Lyon and J. Daniel Brito *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1031-1042 (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

Theories regarding the radiation of sound are reviewed and the implementation in strategies for explaining or measuring the sound produced by practical strucutres are discussed. Particular attention is given to those aspects that relate to the determination of the relative amounts of sound generated by various parts of a machine or structure, which can be very useful information for noise reduction efforts. Author

N77-10325*# Massachusetts Inst. of Tech., Cambridge. Acoustics and Vibration Lab.
ON THE RADIATION OF SOUND FROM BAFFLED FINITE PANELS **c39**
Patrick Leehey *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1043-1055 refs Sponsored by Navy (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

Theoretical and experimental research on structural-acoustic interaction is reviewed. The emphasis is upon the radiation from and acoustic loading of baffled rectangular plates and membranes. The topics discussed include a criterion for strong radiation loading, the mass law for a finite panel, numerical calculation of the radiation impedance of a finite panel in the presence of a parallel mean flow, and experimental determination of the effect of vibration amplitude and Mach number upon panel radiation efficiency. Author

N77-10326*# Princeton Univ., N.J.
ACOUSTOELASTICITY **c39**
Earl H. Dowell *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1057-1070 refs (For primary document see N77-10305 01-31)
(Grant NsG-1253)
Avail: NTIS HC A20/MF A01

Internal sound fields are considered. Specifically, the interaction between the (acoustic) sound pressure field and the (elastic) flexible wall of an enclosure is discussed. Such problems frequently arise when the vibrating walls of a transportation vehicle induce a significant internal sound field. Cabin noise in various flight vehicles and the internal sound field in an automobile are representative examples. A mathematical model, simplified solutions, and numerical results and comparisons with representative experimental data are briefly considered. An overall conclusion is that reasonable grounds for optimism exist with respect to available theoretical models and their predictive capability. Author

N77-10327*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SOUND RADIATION FROM RANDOMLY VIBRATING BEAMS OF FINITE CIRCULAR CROSS SECTION **c39**
M. W. Sutterlin and A. D. Pierce (Ga. Inst. of Technol.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1071-1081 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

The radiation of sound from vibrating cylindrical beams is analyzed based on the frequency of the beam vibrations and the physical characteristics of the beam and its surroundings. A statistical analysis of random beam vibrations allows this result to be independent of the boundary conditions at the ends of the beam. The acoustic power radiated by the beam can be determined from a knowledge of the frequency band vibration data without a knowledge of the individual modal vibration amplitudes. A practical example of the usefulness of this technique is provided by the application of the theoretical calculations to the prediction of the octave band acoustic power output of the picking sticks of an automatic textile loom. Calculations are made of the expected octave band sound pressure levels based on measured acceleration data. These theoretical levels are subsequently compared with actual sound pressure level measurements of loom noise. Author

N77-10328*# Joint Inst. for Advancement of Flight Sciences, Washington, D. C.
THE DIFFUSION APPROXIMATION. AN APPLICATION TO RADIATIVE TRANSFER IN CLOUDS **c34**
Robert F. Arduini and Bruce R. Barkstrom *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1085-1092 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

It is shown how the radiative transfer equation reduces to the diffusion equation. To keep the mathematics as simple as possible, the approximation is applied to a cylindrical cloud of radius R and height h. The diffusion equation separates in cylindrical coordinates and, in a sample calculation, the solution is evaluated for a range of cloud radii with cloud heights of 0.5 km and 1.0 km. The simplicity of the method and the speed with which solutions are obtained give it potential as a tool with which to study the effects of finite-sized clouds on the albedo of the earth-atmosphere system. Author

N77-10329*# Miami Univ., Fla.
CALIBRATION AND VERIFICATION OF ENVIRONMENTAL MODELS **c46**
Samuel S. Lee, Subrata Sengupta, Norman Weinberg, and Homer Hiser *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1093-1103 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

The problems of calibration and verification of mesoscale models used for investigating power plant discharges are considered. The value of remote sensors for data acquisition is discussed as well as an investigation of Biscayne Bay in southern Florida. D.M.L.

N77-10330*# Joint Inst. for Advancement of Flight Sciences, Washington, D. C.
ON THE ABSORPTION OF SOLAR RADIATION IN A LAYER OF OIL BENEATH A LAYER OF SNOW **c46**
Jack C. Larsen and Bruce R. Barkstrom *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1105-1114 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

Solar energy deposition in oil layers covered by snow is calculated for three model snow types using radiative transfer theory. It is suggested that excess absorbed energy is unlikely to escape, so that some melting is likely to occur for snow depths less than about 4 cm. Author

N77-10331*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE INFLUENCE OF THE DIABATIC HEATING IN THE TROPOSPHERE ON THE STRATOSPHERE **c46**
Richard E. Turner, Kenneth V. Haggard, and Tsing Chang Chen *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1115-1123 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 04A

In order to simulate the seasonal variation of the stratospheric circulation in a zonal mean circulation model, a Newtonian heating function and a detailed heating function were applied to the troposphere and stratosphere, respectively. The purpose of this study was to investigate the response of stratospheric circulation to alterations of the radiative equilibrium temperature of the troposphere. Author

N77-10332*# Instituto de Mecanica Aplicada y Estructuras, Rosario (Argentina).
USE OF VARIATIONAL METHODS IN THE DETERMINATION OF WIND-DRIVEN OCEAN CIRCULATION **c48**
Roberto Gelos (Inst. Argentino de Oceanografia) and Patricio A. A. Laura *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1125-1135 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

Simple polynomial approximations and a variational approach were used to predict wind-induced circulation in rectangular ocean basins. Stommel's and Munk's models were solved in a unified fashion by means of the proposed method. Very good agreement with exact solutions available in the literature was shown to exist. The method was then applied to more complex situations where an exact solution seems out of the question. Author

N77-10333*# Naval Postgraduate School, Monterey, Calif.
OPTICALLY RELEVANT TURBULENCE PARAMETERS IN THE MARINE BOUNDARY LAYER **c48**
K. L. Davidson and T. M. Houlihan *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1137-1151 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

Shipboard measurements of temperature and velocity fluctuations were performed to determine optical propagation properties of the marine boundary layer. Empirical expressions describing the temperature structure parameter in terms of the Richardson Number overland were used to analyze data obtained for open ocean conditions. Likewise, profiles of mean wind and velocity fluctuation spectra derived from shipboard observations were utilized to calculate associated boundary layer turbulence parameters. In general, there are considerable differences between the open-ocean results of this study and previously determined overland results. Author

N77-10334*# Cornell Univ., New York.
THE NUMERICAL PREDICTION OF TORNADIC WIND-STORMS **c47**
Douglas A. Paine and Michael L. Kaplan (Joint Inst. for Advan. of Flight Sci.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1153-1165 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

Rather than treating localized severe weather events as being purely statistical in nature, a mathematical framework was developed based on the concept of a deterministic cascade of energy-momentum which bridges the gap between the longest and shortest of atmospheric wave phenomena. This cascade relieves macroscale wavelengths (> 1000 km) of mass-momentum imbalances by exciting convective phenomena (< 10km) through a sophisticated transfer process involving intermediate, mesoscale wavelengths. Author

N77-10335*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER IN THE WIND TUNNEL FOR MODELING OF WIND LOADS ON LOW-RISE STRUCTURES **c39**
Henry W. Tieleman, Timothy A. Reinhold, and Richard D. Marshall (NBS, Washington, D. C.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1167-1176 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

The lower part of the atmospheric boundary layer (strong wind conditions) was simulated in low speed wind tunnel for the modeling of wind loads on low-rise structures. The turbulence characteristics of the turbulent boundary layer in the wind tunnel

are compared with full scale measurements and with measurements made at NASA Wallops Flight Center. Wind pressures measured on roofs of a 1:70 scale model of a small single family dwelling were compared with results obtained from full scale measurements. The results indicate a favorable comparison between full scale and model pressure data as far as mean, r.m.s. and peak pressures are concerned. In addition, results also indicate that proper modeling of the turbulence is essential for proper simulation of the wind pressures. Author

N77-10336*# California Univ., Livermore. Lawrence Livermore Lab.
NUMERICAL SIMULATION OF TORNADO WIND LOADING ON STRUCTURES **c39**
Dennis E. Maiden *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1177-1190 refs (For primary document see N77-10305 01-31)
(Contract W-7405-eng-48)
Avail: NTIS HC A20/MF A01

A numerical simulation of a tornado interacting with a building was undertaken in order to compare the pressures due to a rotational unsteady wind with that due to steady straight winds used in design of nuclear facilities. The numerical simulations were performed on a two-dimensional compressible hydrodynamics code. Calculated pressure profiles for a typical building were then subjected to a tornado wind field and the results were compared with current quasisteady design calculations. The analysis indicates that current design practices are conservative. Author

N77-10337*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE MAKING OF THE ATMOSPHERE **c46**
Joel S. Levine *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1191-1201 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 04A

A model for the evolution of the earth's atmosphere is proposed in which the atmosphere and oceans are assumed to have accumulated as a result of volatile outgassing from the earth's interior. The bulk of the outgassed volatiles were originally trapped within the solid earth during the planetary accretion process, while other volatiles resulted from radiogenic decay within the solid earth. Atmospheric oxygen resulted from the photodissociation of water vapor during the earth's early history and from photosynthetic activity in more recent times. The origin and evolution of atmospheric ozone is closely related to the growth of oxygen. The rise of ozone and the evolution of life is discussed in terms of an evolving oxygen atmosphere. Author

N77-10338*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ATMOSPHERIC ENGINEERING OF MARS **c91**
R. D. MacElroy and M. M. Averner *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1203-1214 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 03B

The feasibility of creating a breathable atmosphere on Mars was studied. Assuming that indigenous life is absent, and that human habitation will prove economically justifiable, several methods of introducing oxygen were considered. On the basis of energy requirements, photosynthetic oxygen production appears to be reasonable, assuming that the amounts of water, carbon dioxide, and mineral nutrients available on the Martian surface would be adequate for the growth of photosynthetic microorganisms. However, optimum rates of O2 formation could occur only after a significant increase in average temperature and in atmospheric mass. The generation of a runaway greenhouse/advective effect was considered. However, neither the energy requirement nor the time constant for initiation could be calculated. There appear to be no insuperable obstacles to the conversion of the Martian atmosphere to one containing oxygen, but the conversion would require many thousands of years. Author

N77-10339*# Stanford Research Inst., Menlo Park, Calif.
CREATION OF AN ARTIFICIAL ATMOSPHERE ON THE MOON **c91**
Richard R. Vondrak *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1215-1223 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

Evaluation of possible methods of gas production indicates that it is technologically feasible to create an artificial long-lived lunar atmosphere. Author

N77-10340*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A TWO-DIMENSIONAL STRATOSPHERIC MODEL OF THE DISPERSION OF AEROSOLS FROM THE FUEGO VOLCANIC ERUPTION **c46**
Ellis E. Remsberg, Carolyn F. Jones (Vought Corp., Hampton, Va.), and Jae Park (Coll. of William and Mary, Williamsburg, Va.) *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1225-1233 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 04A

Observational data of the pre- and post-volcanic aerosols from the eruption of the Volcan de Fuego in Guatemala (15 deg N) in October 1974 were used in conjunction with predictions of a 2-D circulation model to gain better understanding of the transport, chemical and sedimentation processes which determine the stratospheric aeosol layer. Author

N77-10341*# George Washington Univ., Washington, D.C.
SOLAR ENERGY STORAGE AND UTILIZATION **c44**
S. W. Yuan and A. M. Bloom *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1235-1246 (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

A method of storing solar energy in the ground for heating residential buildings is described. The method would utilize heat exchanger pipes with a circulating fluid to transfer the energy beneath the surface as well as to extract the stored energy. D.M.L.

N77-10342*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOLAR HOT WATER SYSTEMS APPLICATION TO THE SOLAR BUILDING TEST FACILITY AND THE TECH HOUSE **c44**
Ross L. Goble, Ronald N. Jensen, and Robert C. Basford *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1237-1246 (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 10A

Projects which relate to the current national thrust toward demonstrating applied solar energy are discussed. The first project has as its primary objective the application of a system comprised of a flat plate collector field, an absorption air conditioning system, and a hot water heating system to satisfy most of the annual cooling and heating requirements of a large commercial office building. The other project addresses the application of solar collector technology to the heating and hot water requirements of a domestic residence. In this case, however, the solar system represents only one of several important technology items, the primary objective for the project being the application of space technology to the American home. Author

N77-10343*# General Electric Co., Philadelphia, Pa. Research and Development Center.
THE dc ARC CHARACTERISTICS IN SUBSONIC ORIFICE NOZZLE FLOW **c34**
Henry T. Nagamatsu and Richard E. Kinsinger *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1247-1264 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

The cold air flow field for a 1/27 cm orifice nozzle was determined for subsonic flow velocities. In addition, d.c. arc voltage, current, and diameter measurements were made for a range of velocities and arc gaps. Average voltage gradients increased rapidly as an arc extinguishing velocity was approached. Measured values of current and diameter were used as an input for relaxation solution of an energy balance equation to compute radial temperature profiles. Calculated arc voltage gradients compare favorably with measured average voltage gradients. Author

N77-10344*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYDROGEN-FUELED SUBSONIC AIRCRAFT: A PERSPECTIVE c28
Robert D. Witcofski *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1265-1278 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 21D

The performance characteristics of hydrogen-fueled subsonic transport aircraft are compared to those using conventional aviation kerosene. Additional aspects discussed include potential improvements in the exhaust emissions characteristics of aircraft jet engines, problems associated with onboard fuel containment, results of recent studies of the impact of hydrogen-fueled aircraft on the airport and associated ground support equipment, and estimates of the cost and thermal efficiency of producing synthetic aviation fuels from coal. Author

N77-10345*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCES IN ENGINEERING SCIENCE, VOLUME 4
1976 521 p refs Presented at 13th Ann. Meeting of Soc. of Eng. Sci., Hampton, Va., 1-3 Nov. 1976; sponsored by JIAFS and George Washington Univ. 4 Vol.
(NASA-CP-2001-Vol-4) Avail: NTIS HC A22/MF A01 CSCL 13M

The following areas of flight science are discussed in detail; (1) inviscid flow, (2) viscous flow, (3) aircraft aerodynamics, (4) fluid mechanics, (5) propulsion and combustion, and (6) fluid dynamics and control. For individual titles, see N77-10346 through N77-10383.

N77-10346*# Naval Research Lab., Washington, D.C.
FLUX-CORRECTED TRANSPORT TECHNIQUES FOR TRANSIENT CALCULATIONS OF STRONGLY SHOCKED FLOWS c34
J. P. Boris *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1291-1300 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

New flux-corrected transport algorithms are described for solving generalized continuity equations. These techniques were developed by requiring that the finite difference formulas used ensure positivity for an initially positive convected quantity. Thus FCT is particularly valuable for fluid-like problems with strong gradients or shocks. Repeated application of the same subroutine to mass, momentum, and energy conservation equations gives a simple solution of the coupled time-dependent equations of ideal compressible fluid dynamics without introducing an artificial viscosity. FCT algorithms span Eulerian, sliding-rezone, and Lagrangian finite difference grids in several coordinate systems. The latest FCT techniques are fully vectorized for parallel/pipeline processing. Author

N77-10347*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
LIFTING SURFACE THEORY FOR RECTANGULAR WINGS c02
Fred R. DeJarnette *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1301-1309 refs (For primary document see N77-10345 01-31)
(Grant DAAG29-76-G-0045)
Avail: NTIS HC A22/MF A01

A new incompressible lifting-surface theory is developed for thin rectangular wings. The solution requires the downwash equation to be in the form of Cauchy-type integrals. Lan's method is employed for the chordwise integrals since it properly accounts for the leading-edge singularity, Cauchy singularity and Kutta condition. The Cauchy singularity in the spanwise integral is also accounted for by using the midpoint trapezoidal rule and theory of Chebychev polynomials. The resulting matrix equation, formed by satisfying the boundary condition at control points, is simpler and quicker to compute than other lifting surface theories. Solutions were found to converge with only a small number of control points and to compare favorably with results from other methods. Author

N77-10348*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IMPROVED COMPUTATIONAL TREATMENT OF TRANSONIC FLOW ABOUT SWEPT WINGS c02
W. F. Ballhaus (AMRDL), F. R. Bailey, and J. Frick (Informatics, Inc., Palo Alto, Calif.) *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1311-1320 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 01A

Relaxation solutions to classical three-dimensional small-disturbance (CSD) theory for transonic flow about lifting swept wings are reported. For such wings, the CSD theory was found to be a poor approximation to the full potential equation in regions of the flow field that are essentially two-dimensional in a plane normal to the sweep direction. The effect of this deficiency on the capture of embedded shock waves in terms of (1) the conditions under which shock waves can exist and (2) the relations they must satisfy when they do exist is emphasized. A modified small-disturbance (MSD) equation, derived by retaining two previously neglected terms, was proposed and shown to be a consistent approximation to the full potential equation over a wider range of sweep angles. The effect of these extra terms is demonstrated by comparing CSD, MSD, and experimental wing surface pressures. Author

N77-10349*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
APPLICATION OF THE NONLINEAR VORTEX-LATTICE CONCEPT TO AIRCRAFT-INTERFERENCE PROBLEMS c02
Osama A. Kandil, Dean T. Mook, and Ali H. Nayfeh *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1321-1330 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

A discrete-vortex model was developed to account for the hazardous effects of the vortex trail issued from the edges of separation of a large leading wing on a small trailing wing. The model is divided into three main parts: the leading wing and its near wake, the near and far wakes of the leading wing, and the trailing wing and the portion of the far wake in its vicinity. The normal force, pitching moment, and rolling moment coefficients for the trailing wing are calculated. The circulation distribution in the vortex trail is calculated in the first part of the model where the leading wing is far upstream and hence is considered isolated. A numerical example is solved to demonstrate the feasibility of using this method to study interference between aircraft. The numerical results show the correct trends: The following wing experiences a loss in lift between the wing-tip vortex systems of the leading wing, a gain outside this region, and strong rolling moments which can change sign as the lateral relative position changes. All the results are strongly dependent on the vertical relative position. Author

N77-10350*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN APPLICATION OF THE SUCTION ANALOG FOR THE ANALYSIS OF ASYMMETRIC FLOW SITUATIONS c02
James M. Luckring *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1331-1347 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 01A

A recent extension of the suction analogy for estimation of vortex loads on asymmetric configurations is reviewed. This extension includes asymmetric augmented vortex lift and the forward sweep effect on side edge suction. Application of this extension to a series of skewed wings has resulted in an improved estimating capability for a wide range of asymmetric flow situations. Hence, the suction analogy concept now has more general applicability for subsonic lifting surface analysis. Author

N77-10351*# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
TRANSONIC FLOW THEORY OF AIRFOILS AND WINGS c02
P. R. Garabedian *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1349-1358 refs (For primary document see N77-10345 01-31)
(Grants NGR-33-016-167; NGR-33-016-201; Contract AT(11-1)-3077)
Avail: NTIS HC A22/MF A01

There are plans to use the supercritical wing on the next generation of commercial aircraft so as to economize on fuel

consumption by reducing drag. Computer codes have served well in meeting the consequent demand for new wing sections. The possibility of replacing wind tunnel tests by computational fluid dynamics is discussed. Another approach to the supercritical wing is through shockless airfoils. A novel boundary value problem in the hodograph plane is studied that enables one to design a shockless airfoil so that its pressure distribution very nearly takes on data that are prescribed. Author

N77-10352*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE MULTIGRID METHOD: FAST RELAXATION c02
Jerry C. South, Jr. and Achi Brandt (Weizmann Inst. of Sci., Rehovot, Israel) *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1359-1369 refs (For primary document see N77-10345 01-31)
(Grant NGR-47-102-001)
Avail: NTIS HC A22/MF A01 CSCL 01A

A multi-level grid method was studied as a possible means of accelerating convergence in relaxation calculations for transonic flows. The method employs a hierarchy of grids, ranging from very coarse (e.g. 4 x 2 mesh cells) to fine (e.g. 64 x 32); the coarser grids are used to diminish the magnitude of the smooth part of the residuals, hopefully with far less total work than would be required with optimal iterations on the finest grid. To date the method was applied quite successfully to the solution of the transonic small-disturbance equation for the velocity potential in conservation form. Nonlifting transonic flow past a parabolic arc airfoil is the example studied, with meshes of both constant and variable step size. Author

N77-10353*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF FINITE ELEMENT APPROACH TO TRANSONIC FLOW PROBLEMS c02
Mohamed M. Hafez, Earll M. Murman, and London C. Wellford *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1371-1393 refs (For primary document see N77-10345 01-31)
(Contract NAS1-14246)
Avail: NTIS HC A22/MF A01 CSCL 01A

A variational finite element model for transonic small disturbance calculations is described. Different strategy is adopted in subsonic and supersonic regions, and blending elements are introduced between different regions. In the supersonic region, no upstream effect is allowed. If rectangular elements with linear shape functions are used, the model is similar to Murman's finite difference operators. Higher order shape functions, nonrectangular elements, and discontinuous approximation of shock waves are also discussed. Author

N77-10354*# Texas A&M Univ., College Station.
INVERSE TRANSONIC AIRFOIL DESIGN INCLUDING VISCOUS INTERACTION c02
Leland A. Carlson *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1387-1395 refs (For primary document see N77-10345 01-31)
(Grant NsG-1174)
Avail: NTIS HC A22/MF A01

A numerical technique was developed for the analysis of specified transonic airfoils or for the design of airfoils having a prescribed pressure distribution, including the effect of weak viscous interaction. The method uses the full potential equation, a stretched Cartesian coordinate system, and the Nash-MacDonald turbulent boundary layer method. Comparisons with experimental data for typical transonic airfoils show excellent agreement. An example shows the application of the method to design a thick aft-cambered airfoil, and the effects of viscous interaction on its performance are discussed. Author

N77-10355*# Mississippi State Univ., Mississippi State.
NUMERICAL SOLUTIONS FOR LAMINAR AND TURBULENT VISCOUS FLOW OVER SINGLE AND MULTI-ELEMENT AIRFOILS USING BODY-FITTED COORDINATE SYSTEMS c02
Joe F. Thompson, Z. U. A. Warsi, and B. B. Amlicke *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1397-1407 refs (For primary document see N77-10345 01-31)
(Grants NGR-25-001-005; AF-AFOSR-2922-76)
Avail: NTIS HC A22/MF A01

The technique of body-fitted coordinate systems is applied in numerical solutions of the complete time-dependent compressible and incompressible Navier-Stokes equations for laminar flow and to the time-dependent mean turbulent equations closed by modified Kolmogorov hypotheses for turbulent flow. Coordinate lines are automatically concentrated near to the bodies at higher Reynolds number so that accurate resolution of the large gradients near the solid boundaries is achieved. Two-dimensional bodies of arbitrary shapes are treated, the body contour(s) being simply input to the program. The complication of the body shape is thus removed from the problem. Author

N77-10356*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
THREE-DIMENSIONAL BOUNDARY LAYERS APPROACHING SEPARATION c02
James C. Williams, III *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1409-1421 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

The theory of semi-similar solutions of the laminar boundary layer equations is applied to several flows in which the boundary layer approaches a three-dimensional separation line. The solutions obtained are used to deduce the nature of three-dimensional separation. It is shown that in these cases separation is of the 'ordinary' type. A solution is also presented for a case in which a vortex is embedded within the three-dimensional boundary layer. Author

N77-10357*# Michigan Univ., Ann Arbor.
SHOCK WAVE-TURBULENT BOUNDARY LAYER INTERACTIONS IN TRANSONIC FLOW c02
T. C. Adamson and A. F. Messiter *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1425-1435 refs (For primary document see N77-10345 01-31)
(Grant NGR-23-005-523)
Avail: NTIS HC A22/MF A01

The method of matched asymptotic expansions is used in analyzing the structure of the interaction region formed when a shock wave impinges on a turbulent flat plate boundary layer in transonic flow. Solutions in outer regions, governed by inviscid flow equations, lead to relations for the wall pressure distribution. Solutions in the inner regions, governed by equations in which Reynolds and/or viscous stresses are included, lead to a relation for the wall shear stress. Solutions for the wall pressure distribution are reviewed for both oblique and normal incoming shock waves. Solutions for the wall shear stress are discussed. Author

N77-10358*# Ohio State Univ., Columbus.
SEPARATED LAMINAR BOUNDARY LAYERS c02
Odus R. Burggraf *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1437-1450 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

Classical boundary layer theory is inadequate to deal with the problem of flow separation owing to its underlying assumption that the boundary layer has an insignificant effect on the external stream. This difficulty is resolved by a theory which includes interaction with the external flow. This theory is described from the viewpoint of the asymptotic triple deck structure. Several triple deck studies are reviewed with emphasis on results of interest in aeronautical applications. Author

N77-10359*# Cincinnati Univ., Ohio.
NUMERICAL AND APPROXIMATE SOLUTION OF THE HIGH REYNOLDS NUMBER SMALL SEPARATION PROBLEM c34
R. T. Davis *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1451-1465 refs (For primary document see N77-10345 01-31)
(Contracts N00014-76-C-0364; N00014-76-C-0359)
Avail: NTIS HC A22/MF A01

Several possible methods of solving the small separation problem at high Reynolds number are investigated. In addition to using analytical methods, there are several numerical approaches which are used. High Reynolds number laminar two dimensional problems are used for simplicity. A brief discussion

is given of the finite difference methods since these methods are discussed in detail. Most of the emphasis is placed on developing an approximate integral method. As a model problem the supersonic compression ramp problem is chosen since several numerical solutions along with experimental data are available. The techniques discussed are modified and applied to other similar type wall geometries. Author

N77-10360*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE RELATIVE MERITS OF SEVERAL NUMERICAL TECHNIQUES FOR SOLVING THE COMPRESSIBLE NAVIER-STOKES EQUATIONS c34
Terry L. Holst *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1467-1481 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 20D

Four explicit finite difference techniques designed to solve the time-dependent, compressible Navier Stokes equations are compared. These techniques are: (1) MacCormack, (2) modified Du Fort-Frankel, (3) modified hopscotch, and (4) Brailovskaya. The comparison was made numerically by solving the quasi-one dimensional Navier Stokes equations for the flow in a converging-diverging nozzle. Solutions with and without standing normal shock waves were computed for unit Reynolds numbers (based on total conditions) ranging from 45374 to 2269. The results indicate that all four techniques are comparable in accuracy; however, the modified hopscotch scheme is two to three times faster than the Brailovskaya and MacCormack schemes and three to six times faster than the modified Du Fort-Frankel scheme. Author

N77-10361*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CALCULATION OF A SEPARATED TURBULENT BOUNDARY LAYER c34
Barrett Baldwin and Ching Mao Hung *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1483-1492 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 20D

The properties of a Navier-Stokes solution of a shock-separated turbulent flow over a flat wall are investigated. Refinements of an algebraic relaxation turbulence model previously shown to be of value for the simulation of separated flows are presented. A simplified analysis applicable near an adiabatic wall is developed and used to help verify the accuracy of the numerical solution. Features of the time-dependent response of a turbulent boundary layer to shock impingement are presented. Author

N77-10362*# Old Dominion Univ., Norfolk, Va.
THE LIFT FORCE ON A DROP IN UNBOUNDED PLANE POISEUILLE FLOW c34
Philip R. Wohl *In* NASA Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1493-1504 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

The lift force on a deformable liquid sphere moving in steady, plane Poiseuille-Stokes flow and subjected to an external body force is calculated. The results are obtained by seeking a solution to Stokes' equations for the motion of the liquids inside and outside the slightly perturbed sphere surface, as expansions valid for small values of the ratio of the Weber number to the Reynolds number. When the ratio of the drop and external fluid viscosities is small, the lift exerted on a neutrally buoyant drop is found to be approximately one-tenth of the magnitude of the force reported by Wohl and Rubinow acting on the same drop in unbounded Poiseuille flow in a tube. The resultant trajectory of the drop is calculated and displayed as a function of the external body force. Author

N77-10363*# Oregon State Univ., Corvallis.
STABILITY OF FLOW OF A THERMOVISCOELASTIC FLUID BETWEEN ROTATING COAXIAL CIRCULAR CYLINDERS c34
Nabil N. Ghandour and M. N. L. Narasimhan *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1505-1507 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

The stability problem of thermoviscoelastic fluid flow between rotating coaxial cylinders is investigated using nonlinear thermoviscoelastic constitutive equations due to Eringen and Koh. The velocity field is found to be identical with that of the classical viscous case and the case of the viscoelastic fluid, but the temperature and pressure fields are found to be different. By imposing some physically reasonable mechanical and geometrical restrictions on the flow, and by a suitable mathematical analysis, the problem is reduced to a characteristic value problem. The resulting problem is solved and stability criteria are obtained in terms of critical Taylor numbers. In general, it is found that thermoviscoelastic fluids are more stable than classical viscous fluids and viscoinelastic fluids under similar conditions. Author

N77-10364*# Oakland Univ., Rochester, Mich.
STABILITY OF A VISCOUS FLUID IN A RECTANGULAR CAVITY IN THE PRESENCE OF A MAGNETIC FIELD c34
C. Y. Liang and Y. Y. Hung *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1509-1519 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

The stability of an electrically conducting fluid subjected to two dimensional disturbance was investigated. A physical system consisting of two parallel infinite vertical plates which are thermallly insulated was studied. An external magnetic field of constant strength was applied to normal plates. The fluid was heated from below so that a steady temperature gradient was maintained in the fluid. The governing equations were derived by perturbation technique, and solutions were obtained by a modified Galerkin method. It was found that the presence of the magnetic field increases the stability of the physical system and instability can occur in the form of neutral or oscillatory instability. Author

N77-10365*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCED TRANSONIC AERODYNAMIC TECHNOLOGY c02
Richard T. Whitcomb *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1521-1537 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 01A

Supercritical airfoils and their applications to wings for various types of aircraft are studied. The various wings discussed were designed for a subsonic jet transport with increased speed, a variable sweep fighter with greater transonic maneuverability, a high subsonic speed STOL jet transport with improved low speed characteristics, and a subsonic jet transport with substantially improved aerodynamic efficiency. Results of wind tunnel and flight demonstration investigations are described. Also discussed are refinements of the transonic area rule concept and methods for reducing the aerodynamic interference between engine nacelles and wings at high subsonic speeds. Author

N77-10366*# Lockheed-Georgia Co., Marietta.
DESIGN CONSIDERATIONS FOR LAMINAR FLOW CONTROL AIRCRAFT c05
R. F. Sturgeon and J. A. Bennett *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1539-1548 refs (For primary document see N77-10345 01-31)
(Contract NAS1-13694)
Avail: NTIS HC A22/MF A01

A study was conducted to investigate major design considerations involved in the application of laminar flow control to the wings and empennage of long range subsonic transport aircraft compatible with initial operation in 1985. For commercial transports with a design mission range of 10,186 km (5500 n mil) and a payload of 200 passengers, parametric configuration analyses were conducted to evaluate the effect of aircraft performance, operational, and geometric parameters on fuel efficiency. Study results indicate that major design goals for aircraft optimization include maximization of aspect ratio and wing loading and minimization of wing sweep consistent with wing volume and airport performance requirements. Author

N77-10367*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
ON THE STATUS OF V/STOL FLIGHT c05
Barnes W. McCormick *In* NASA. Langley Res. Center Advan.

in Eng. Sci., Vol. 4 1976 p 1549-1562 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

Basic principles relating to the accomplishment of V/STOL flight are reviewed as they pertain to current prototype developments. Particular consideration is given to the jet flap, flow augmentation and circulation control separately and in combination. Configurations as the augmentor wing, upper-surface blown flaps, externally blown flaps and the circulation-controlled rotor are also examined. Author

N77-10368*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE CRYOGENIC WIND TUNNEL c09
Robert A. Kilgore *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1565-1581 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 14B

Based on theoretical studies and experience with a low speed cryogenic tunnel and with a 1/3-meter transonic cryogenic tunnel, the cryogenic wind tunnel concept was shown to offer many advantages with respect to the attainment of full scale Reynolds number at reasonable levels of dynamic pressure in a ground based facility. The unique modes of operation available in a pressurized cryogenic tunnel make possible for the first time the separation of Mach number, Reynolds number, and aeroelastic effects. By reducing the drive-power requirements to a level where a conventional fan drive system may be used, the cryogenic concept makes possible a tunnel with high productivity and run times sufficiently long to allow for all types of tests at reduced capital costs and, for equal amounts of testing, reduced total energy consumption in comparison with other tunnel concepts. Author

N77-10369*# George Washington Univ., Washington, D.C. Joint Inst. for Advancement of Flight Sciences.
DESIGN CONSIDERATIONS OF THE NATIONAL TRANSONIC FACILITY c09
Donald D. Baals *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1583-1602 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

The inability of existing wind tunnels to provide aerodynamic test data at transonic speeds and flight Reynolds numbers was examined. The proposed transonic facility is a high Reynolds number transonic wind tunnel designed to meet the research and development needs of industry, and the scientific community. The facility employs the cryogenic approach to achieve high transonic Reynolds numbers at acceptable model loads and tunnel power. By using temperature as a test variable, a unique capability to separate scale effects from model aeroelastic effects is provided. The performance envelope of the facility is shown to provide a ten fold increase in transonic Reynolds number capability compared to currently available facilities. Author

N77-10370*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC MEASUREMENT TECHNIQUES c36
William W. Hunter, Jr. *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1603-1614 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 20E

Laser characteristics of intensity, monochromatic, spatial coherence, and temporal coherence were developed to advance laser based diagnostic techniques for aerodynamic related research. Two broad categories of visualization and optical measurements were considered, and three techniques received significant attention. These are holography, laser velocimetry, and Raman scattering. Examples of the quantitative laser velocimeter and Raman scattering measurements of velocity, temperature, and density indicated the potential of these nonintrusive techniques. Author

N77-10371*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
HYPERSONIC HEAT-TRANSFER AND TRANSITION CORRELATIONS FOR A ROUGHENED SHUTTLE ORBITER c34
John J. Bertin (Texas Univ., Austin), Dennis D. Stalmach (Texas Univ., Austin), Ed S. Idar (Texas Univ., Austin), Dennis B. Conley (Texas Univ., Austin), and Winston D. Goodrich *In its* Advan. In Eng. Sci., Vol. 4 1976 p 1615-1627 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 20D

The effect of roughness on the heat transfer distributions and the transition criteria for the windward pitch plane of the shuttle orbiter at an angle of attack of 30 deg was studied using data obtained in hypersonic wind tunnels. The heat transfer distributions and the transition locations for the roughened models were compared with the corresponding data for smooth models. The data were correlated using theoretical solutions for a nonsimilar, laminar boundary layer subject to two different flow field models for the orbiter. Author

N77-10372*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYDROGEN-FUELED SCRAMJETS: POTENTIAL FOR DETAILED COMBUSTOR ANALYSIS c07
H. L. Beach, Jr. *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1629-1639 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 21A

Combustion research related to hypersonic scramjet (supersonic combustion ramjet) propulsion is discussed from the analytical point of view. Because the fuel is gaseous hydrogen, mixing is single phase and the chemical kinetics are well known; therefore, the potential for analysis is good relative to hydro-carbon fueled engines. Recent progress in applying two and three dimensional analytical techniques to mixing and reacting flows indicates cause for optimism, and identifies several areas for continuing effort. Author

N77-10373*# Vanderbilt Univ., Nashville, Tenn.
THREE-DIMENSIONAL FINITE ELEMENT ANALYSIS OF ACOUSTIC INSTABILITY OF SOLID PROPELLANT ROCKET MOTORS c20
Robert M. Hackett and Radwan S. Juruf *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1641-1651 refs (For primary document see N77-10345 01-31)
(Contract DAHC04-72-A-0001)
Avail: NTIS HC A22/MF A01

A three dimensional finite element solution of the acoustic vibration problem in a solid propellant rocket motor is presented. The solution yields the natural circular frequencies of vibration and the corresponding acoustic pressure mode shapes, considering the coupled response of the propellant grain to the acoustic oscillations occurring in the motor cavity. The near incompressibility of the solid propellant is taken into account in the formulation. A relatively simple example problem is solved in order to illustrate the applicability of the analysis and the developed computer code. Author

N77-10374*# Oklahoma Univ., Norman.
ACOUSTIC DISTURBANCES PRODUCED BY AN UNSTEADY SPHERICAL DIFFUSION FLAME c71
Maurice L. Rasmussen *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1653-1664 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

The disturbances produced by a moving spherical diffusion flame are investigated within the framework of a linearized theory. After the flame position and species concentrations are determined, the problem of determining the associated density, pressure, temperature, and velocity fields is delineated. Explicit results for certain limiting situations are discussed. Author

N77-10375*# Texas Univ., Austin.
FLOW FIELD FOR AN UNDEREXPANDED, SUPERSONIC NOZZLE EXHAUSTING INTO AN EXPANSIVE LAUNCH TUBE c20
Robert R. Morris, John J. Bertin, and James L. Batson, (Army Missile Command) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1665-1671 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

Static pressure distributions along the launcher wall and pitot pressure measurements from the annular region between the rocket and the launcher were made as an underexpanded supersonic nozzle exhausted into an expansive launch tube. The

flow remained supersonic along the entire length of the launcher for all nozzle locations studied. Author

N77-10376*# Alabama Univ., Tuscaloosa.
EFFECTS OF PERIODIC UNSTEADINESS OF A ROCKET ENGINE PLUME ON THE PLUME-INDUCED SEPARATION SHOCK WAVE **c20**
Julian O. Doughty *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1673-1683 refs (For primary document see N77-10345 01-31)
(Contract NAS8-30624)
Avail: NTIS HC A22/MF A01

A wind tunnel investigation was conducted to study the flow field in which separation is caused by an expanding plume, with emphasis on effects associated with periodic unsteadiness in the plume. The separation shock was photographed with high speed motion pictures, from which mean shock position and excursion data are reported. Pressure fluctuations were measured beneath the separation shock and statistics of the results are reported. A response of the separation shock to plume periodic unsteadiness was identified, and the magnitude of a corresponding transfer function was defined and is reported. Author

N77-10377*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESIGN OF ACTIVE CONTROLS FOR THE NASA F-8 DIGITAL FLY-BY-WIRE AIRPLANE **c08**
Joseph Gera *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1687-1701 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 01C

The design of a set of control laws for the NASA F-8 digital fly by wire research airplane is described. These control laws implement several active controls functions: maneuver load control, ride smoothing and departure boundary limiting. The criteria and methods which were used in the design of the control laws are also included. Results of linear analyses and nonlinear simulation are summarized. Author

N77-10378*# Aerospace Systems, Inc., Burlington, Mass.
PERFORMANCE ANALYSIS OF FLEXIBLE AIRCRAFT WITH ACTIVE CONTROL **c08**
Richard B. Noll and Luigi Morino (Boston Univ.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1703-1711 refs (For primary document see N77-10345 01-31)
(Contract NAS1-13371)
Avail: NTIS HC A22/MF A01

Small perturbation equations of motion of a flexible aircraft with an active control technology (ACT) system were developed to evaluate the stability and performance of the controlled aircraft. The total aircraft system was formulated in state vector format and the system of equations was completed with fully unsteady and low frequency aerodynamics for arbitrary, complex configurations based on a potential aerodynamic method. The ACT system equations were incorporated in the digital computer program FCAP (Flight Control Analysis Program) which can be used for the analysis of complete aircraft configurations, including control system, with either low frequency or fully unsteady aerodynamics. The application of classical performance analyses including frequency response, poles and zeros, mean square response, and time response in FCAP in state vector format was discussed. Author

N77-10379*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
BEST-RANGE FLIGHT CONDITIONS FOR CRUISE-CLIMB FLIGHT OF A JET AIRCRAFT **c05**
Francis J. Hale *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1713-1719 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

The Breguet range equation was developed for cruise climb flight of a jet aircraft to include the climb angle and is then maximized with respect to the no wind true airspeed. The expression for the best range airspeed is a function of the specific fuel consumption and minimum drag airspeed and indicates that an operational airspeed equal to the fourth root of three times the minimum-drag airspeed introduces range penalties of the order of one percent. Author

N77-10380*# Cincinnati Univ., Ohio.
EXPERIMENT DESIGN FOR PILOT IDENTIFICATION IN COMPENSATORY TRACKING TASKS **c54**
William R. Wells *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1721-1731 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

A design criterion for input functions in laboratory tracking tasks resulting in efficient parameter estimation is formulated. The criterion is that the statistical correlations between pairs of parameters be reduced in order to minimize the problem of nonuniqueness in the extraction process. The effectiveness of the method is demonstrated for a lower order dynamic system. Author

N77-10381*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESULTS OF RECENT NASA STUDIES ON AUTOMATIC SPIN PREVENTION FOR FIGHTER AIRCRAFT **c08**
Joseph R. Chambers and Luat T. Nguyen *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1733-1751 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 01C

A broad based research program was developed to eliminate or minimize inadvertent spins for advanced military aircraft. Recent piloted simulator studies and airplane flight tests have demonstrated that the automatic control systems in use on current fighters can be tailored to provide a high degree of spin resistance for some configurations without restrictions to maneuverability. Such systems result in greatly increased tactical effectiveness, safety, and pilot confidence. Author

N77-10382*# Analytic Sciences Corp., Washington, D.C.
HIGH ANGLE-OF-ATTACK STABILITY-AND-CONTROL ANALYSIS **c08**
Robert F. Stengel *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1753-1766 refs (For primary document see N77-10345 01-31)
(Contracts NAS1-13618; N00014-75-C-0432)
Avail: NTIS HC A22/MF A01

Methods of linear systems analysis were applied to mathematical models of aircraft flying at high angle of attack and maneuver rate. First order longitudinal and lateral directional coupling is obtained by linearizing the complete nonlinear equations of motion about a generalized (quasi steady) trim point. Open loop stability boundaries are defined using the linear dynamic equations, and pilot in the loop effects are presented. Stability augmentation structures for maneuvering flight conditions are shown to be defined readily using optimal control theory. Author

N77-10383*# Youngstown State Univ., Ohio.
TERMINAL AREA GUIDANCE ALONG CURVED PATHS: A STOCHASTIC CONTROL APPROACH **c04**
J. E. Quaranta and R. H. Foulkes, Jr. *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1767-1777 refs (For primary document see N77-10345 01-31)
(Grant NsG-1199)
Avail: NTIS HC A22/MF A01

Stochastic control theory is applied to the problem of designing a digital flight compensator for terminal guidance along a helical flight path as a prelude to landing. The development of aircraft, wind, and measurement models is discussed along with a control scheme consisting of feedback gains multiplying estimate of the aircraft and wind states obtained from a Kalman one step predictor. Preliminary results are presented which indicate that the compensator performs satisfactorily in the presence of both steady winds and gusts. Author

N77-10384*# AiResearch Mfg. Co., Los Angeles, Calif.
CRYOGENIC HYDROGEN/HELIUM STORAGE AND SUPPLY SYSTEM, PHASE 1 Final Report
R. H. Norman and R. D. Raynor 3 Feb. 1976 98 p
(Contract NAS8-30574)
(NASA-CR-150030; Rept-75-11607) Avail: NTIS HC A05/MF A01 CSCL 20K

An existing cryogenic tank was refurbished, microspheres were installed in the tank annulus, and the thermal performance of the unit was tested. The performance data was compared

with NRC-2 multilayer insulation and low emittance aluminized surfaces installed in tanks of the same basic design. The cryogenic tank modified during the program was originally designed for the Manned Orbiting Laboratory (MOL) Program, and subsequently modified by vacuum-depositing aluminum on all annulus surfaces and leaving out the NRC-2 multilayer insulation. It is concluded that the application of aluminized-microsphere insulation is not yet very predictable for tank design purposes, especially at LH2 temperature and in the presence of a vapor-cooled shield. Author

N77-10385# Du Pont de Nemours (E. I.) and Co., Wilmington, Del.

DEVELOPMENT OF NON-CELLULOSIC RO SYSTEMS FOR SEAWATER DESALTING Final Report

N. W. Rosenblatt, J. P. Agrawal, C. R. Antonson, D. C. Brandt, and D. M. Brethauer Nov. 1975 654 p refs

(Contract DI-14-30-3233)

(PB-252597/0; W76-07318; OWRT-S-76-36) Avail: NTIS HC A99/MF A01 CSCL 07A

Sea water desalting through continued development and testing of the polyamide hydrazide (op-1) film membrane in a spiral configuration is described. Results of testing of polyamide hollow fiber permeators operating at 800 psi and desalting sea water in a single stage are also discussed. A process to continuously cast asymmetric DP-1 film membranes of up to 36 inches width was developed to supply membranes for fabrication of spiral module elements. Small spiral elements desalted sea water at expected flux and rejection levels and maintained stable performance in the field. Most larger elements lost salt rejection rapidly as a result of inadequate flatness of the membrane support (sailcloth) and of wrinkles in the spirally wound leaves. GRA

N77-10386# Oak Ridge National Lab., Tenn.

INSTRUMENTATION GUIDE FOR SEAWATER DISTILLATION PLANTS

R. Philip Hammond Oct. 1972 218 p

(Contracts W-7405-eng-26; DI-14-30-2535)

(PB-252693/7; W76-07320; OWRT-S-76-28) Avail: NTIS HC A10/MF A01 CSCL 07A

The application of generally available instrumentation to multistage flash and vertical tube evaporator types of desalting plants is stipulated. Detailed information on specific instruments is given. Basic information is presented by means of brief discussions of the advantages and limitations of instrumentation components used in desalting plants. The information is restricted to the ranges of parameters (temperatures, pressures, etc.) expected to be encountered in desalting evaporators. GRA

N77-10387# Monsanto Research Corp., Dayton, Ohio.

SOURCE ASSESSMENT: FLAT GLASS MANUFACTURING PLANTS Final Report, Jul. 1974 - Dec. 1975

Richard B. Reznik Mar. 1976 152 p refs

(Contract EPA-68-02-1874)

(PB-252356/1; MRC-DA-507; EPA-600/2-76-032-b) Avail: NTIS HC A08/MF A01 CSCL 11B

Air pollutants emitted during the production of flat glass, SIC No. 3211 is described. Raw materials preparation at the plant site, molten glass production in the melting furnace, and the forming of flat glass products is covered. Melting furnace emissions account for over 99% of the total plant emissions; NO(x), SO(x), and particulates are the major pollutants. The particulates are alkali sulfates of submicron size. NO(x) has the highest emission factor. Source severity is a measure of the potential environmental effect of air emissions from this industry: it is defined as the ratio of the maximum average ground level concentration compared to the primary ambient air quality standard for criteria pollutants. GRA

N77-10388# National Bureau of Standards, Washington, D.C.

METRICATION PROBLEMS IN THE CONSTRUCTION CODES AND STANDARDS SECTOR Final Report

Charles T. Mahaffrey Jun. 1976 28 p

(PB-253666/2; NBS-TN-915) Avail: NTIS HC A03/MF A01 CSCL 13M

The problems to be faced by the building standards development and building regulatory sectors of the American building industry are outlined. It includes a discussion of the SI metric units themselves, giving examples of the conventions regarding their use adopted in other countries to illustrate the nature of the decisions that must be made by the U.S. building industry. It discusses the relationship of dimensional coordination to the metric conversion effort, its impact on the U.S. building regulatory system and illustrates some of the decisions these sectors need to make. It also discusses some of the organizational problems required to involve all segments of the industry in this decision-making process, and for implementing these decisions in a coordinated way on a national scale. GRA

N77-10389# National Bureau of Standards, Washington, D.C.

AN EXTENDED LATTICE MODEL OF LIQUID HELIUM FOUR Final Report

P. H. E. Meijer (Catholic Univ.) and W. D. Scherer (NOAA, Washington, D.C.) 25 Feb. 1975 21 p refs Repr. from Physica (Amsterdam), vol. 80A, no. 5, 1975 p 447-464

(Grant NSF GH-27916)

(PB-252502/0) Avail: NTIS HC A02/MF A01 CSCL 20M

The low and high temperature behavior of liquid 4He is described in terms of an extended lattice model. Paying particular attention to the kinematical interaction and to the hard core of the bosons leads to a unified theory for the low temperature behavior and for the lambda transition. Since the hard core boson operators in the lattice model correspond to spin one half operators, the hamiltonian is interpreted as the hamiltonian of a magnetic system of oblate form. The equations of motion of the creation and annihilation operators are decoupled with the aid of a momentum dependent Bogoliubov-like transformation. GRA

N77-10390# Burns and Roe Construction Corp., Paramus, N.J.

BRACKISH WATER DESALTING TESTING, FIELD EVALUATIONS, OPERATIONS AND MAINTENANCE CONDUCTED AT ROSWELL TEST FACILITY, ROSWELL, NEW MEXICO, DECEMBER 1, 1974 - JULY 31, 1975 Final Report

J. Gallahan, E. Eweldsen, D. Guy, and J. Ward 1976 184 p

(Contract DI-14-30-3296)

(PB-252638/2; OWRT-S-76-35; W76-07319) Avail: NTIS HC A09/MF A01 CSCL 07A

Results are presented of operation, maintenance, and development activities associated with testing of several brackish water membrane desalting pilot plants at the OWRT Roswell Test Facility, Roswell, New Mexico during the period December, 1974 through July, 1975. Evaluation tests were conducted with several reverse osmosis pilot units ranging in capacity from 100 gpd to 90,000 gpd. Major testing programs included continued evaluation of a multi-stage high product recovery pilot plant employing three reverse osmosis stages in series and capable of attaining 90 percent recovery. In addition, test results obtained with experimental thin film composite PA-100 and PA-300 membranes in a spiral wound configuration are described. GRA

N77-10391# Bureau of Mines, College Park, Md. Metallurgy Research Center.

RECYCLING TRENDS IN THE UNITED STATES: A REVIEW

Max J. Spendlove May 1976 29 p refs

(PB-254222/3; BM-IC-8711) Avail: NTIS HC A03/MF A01 CSCL 13B

Support for recycling in the United States is discussed in terms of the growing demand for goods and services of mineral origin and the declining mineral supply. The low probability of meeting future deficits by discovering large new domestic resources or by significantly improving mineral supply and/or energy conversion technologies in the near future is emphasized. Author

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N77-10392* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANTI-MULTIPATH DIGITAL SIGNAL DETECTOR Patent

John H. Painter, inventor (to NASA) Issued 5 Oct. 1976 20 p Filed 25 Mar. 1975 Continuation-in-part of abandoned US Patent Appl. SN-412379, filed 2 Nov. 1973 published under the second Trial Voluntary Protest Program as B 561,764, 27 Jan. 1976 (NASA-Case-LAR-11827-1; US-Patent-3,984,634; US-Patent-Appl-SN-561764; US-Patent-Class-178-88; US-Patent-Class-325-323; US-Patent-Class-325-349; US-Patent-Class-325-476; US-Patent-Class-235-150.1; US-Patent-Class-235-156; US-Patent-Appl-SN-412379) Avail: US Patent Office CSCL 17B

A detector is described for radio signals which have been transmitted through a multipath medium. The device operates in conjunction with the radio frequency portion of a receiver to detect digital signals which have been transmitted in known modulation formats. The transmitted signal is constructed by assigning known and distinct modulation waveforms to a sequence of message symbols, or digits. The basic digital message, which the detector is to reconstruct consists of a sequence of digits, each lasting for a fixed time, say T seconds, and each picked from an alphabet of arbitrary, but fixed, size. For example, in a binary message, the alphabet consists of the digits 0 and 1. In a quarternary message, the alphabet consists of the digits 0, 1, 2, and 3. Official Gazette of the U.S. Patent Office

N77-10393 British Broadcasting Corp., Kingswood (England). Engineering Div.

SATELLITE BROADCASTING: OPTIMAL DISTRIBUTION OF FREQUENCY CHANNELS, ORBITAL POSITIONS AND POLARISATIONS

R. V. Harvey Aug. 1976 14 p refs

(BBC-RD-1976/22) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Some of the factors affecting the viability of a plan of frequency assignments for satellite broadcasting are discussed. The data used by the planner leads logically to a regular distribution of channels, orbital positions and polarizations. Author

N77-10394 British Broadcasting Corp., Kingswood (England). Engineering Div.

A PAL/YUV DIGITAL SYSTEM FOR 625-LINE INTERNATIONAL CONNECTIONS

M. Weston Sep. 1976 15 p refs

(BBC-RD-1976/24) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

The system described is an efficient Y, U, V based digital coding system which could be used for the distribution of color television signals. The system samples Y at 2 f sub sc and (U + V) and (U - V) on alternate lines at f sub sc. These signals are derived using comb-filters in order to reduce high frequency luminance alias and vertical chrominance cross-talk effects. Similar comb-filters can be used to convert between digital Y sub s, (U+V/U-V) and PAL. It is shown that the PAL to Y sub s, (U-V/U-V) to PAL process is almost completely reversible and this has been confirmed by experiment. Author

N77-10395# Texas Instruments, Inc., Dallas.

ATCRBS IMPROVEMENT PROGRAM REFLECTOR ANTENNA DEVELOPMENT Final Report, Apr. 1973 - Mar. 1974

P. N. Richardson Jun. 1976 149 p

(Contract DOT-TSC-602)

(AD-A027875/4; DOT-TSC-FAA-76-3; FAA-RD-76-90) Avail: NTIS HC A07/MF A01 CSCL 17/9

The results of a program to investigate improved antennas for the air traffic control radar beacon system (ATCRBS) are described. An engineering model of a new ATCRBS reflector antenna system was developed and tested. The antenna system was designed primarily for use in terminal area air traffic control, collocated with an airport surveillance radar (ASR). Also developed during this program was an integral beacon feed for the ARSR-2 radar, to give improved beacon coverage for en-route sites. Author

N77-10396*# General Electric Co., Syracuse, N.Y. Optoelectronic Systems Operation.

SOLID STATE TELEVISION CAMERA (CID) Final Technical Report, Aug. 1975 - Aug. 1976

Daniel W. Steele and Wayne T. Green Aug. 1976 113 p

(Contract NAS9-14757)

(NASA-CR-151093) Avail: NTIS HC A06/MF A01 CSCL 17B

The design, development and test are described of a charge injection device (CID) camera using a 244x248 element array. A number of video signal processing functions are included which maximize the output video dynamic range while retaining the inherently good resolution response of the CID. Some of the unique features of the camera are: low light level performance, high S/N ratio, antiblooming, geometric distortion, sequential scanning and AGC. M.C.F.

N77-10397*# California Univ., Berkeley. Space Sciences Lab.

FEASIBILITY OF COHERENT AND INCOHERENT BACKSCATTER EXPERIMENTS FROM THE AMPS LABORATORY. TECHNICAL SECTION Final Report

Forrest S. Mozer Apr. 1976 37 p

(Contract NAS8-31346)

(NASA-CR-144337; SSL-Ser-17-Issue-35) Avail: NTIS HC A03/MF A01 CSCL 17I

A computer program simulated the spectrum which resulted when a radar signal was transmitted into the ionosphere for a finite time and received for an equal finite interval. The spectrum derived from this signal is statistical in nature because the signal is scattered from the ionosphere, which is statistical in nature. Many estimates of any property of the ionosphere can be made. Their average value will approach the average property of the ionosphere which is being measured. Due to the statistical nature of the spectrum itself, the estimators will vary about this average. The square root of the variance about this average is called the standard deviation, an estimate of the error which exists in any particular radar measurement. In order to determine the feasibility of the space shuttle radar, the magnitude of these errors for measurements of physical interest must be understood. Author

N77-10398*# California Univ., Berkeley. Space Sciences Lab.

FEASIBILITY OF COHERENT AND INCOHERENT BACKSCATTER EXPERIMENTS FROM THE AMPS LABORATORY. SUMMARY SECTION Final Report

Forrest S. Mozer Apr. 1976 6 p refs

(Contract NAS8-31346)

(NASA-CR-144338; SSL-Ser-17-Issue-35) Avail: NTIS HC A02/MF A01 CSCL 17I

For abstract, see N77-10397.

N77-10399*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A SEASAT-A SYNTHETIC APERTURE IMAGING RADAR SYSTEM

Rolando L. Jordan and David H. Rodgers [1975] 10 p

(NASA-CR-148838) Avail: NTIS HC A02/MF A01 CSCL 17I

The SEASAT, a synthetic aperture imaging radar system is the first radar system of its kind designed for the study of ocean wave patterns from orbit. The basic requirement of this system is to generate continuous radar imagery with a 100 km swath with 25m resolution from an orbital altitude of 800 km. These requirements impose unique system design problems. The end to end data system described including interactions of the spacecraft, antenna, sensor, telemetry link, and data processor. The synthetic aperture radar system generates a large quantity of data requiring the use of an analog link with stable local oscillator encoding. The problems associated in telemetering the radar information with sufficient fidelity to synthesize an image

on the ground is described as well as the selected solutions to the problems. Author

N77-10400*# Stanford Research Inst., Menlo Park, Calif.
FEASIBILITY OF AN INCOHERENT-SCATTER RADAR ABOARD THE SPACE SHUTTLE Final Report
M. Baron, R. Tsunoda, J. Petriceks, and H. Kunnes Mar. 1976 100 p refs Prepared for Calif. Univ., Berkeley
(Contract NAS8-31346)
(NASA-CR-144336) Avail: NTIS HC A05/MF A01 CSCL 17I

The results of a preliminary study to investigate the feasibility of conducting an incoherent scatter radar experiment on board the space shuttle are presented. The results indicate that such an experiment is technically feasible. The more difficult questions to answer are whether the system can be made flexible enough to justify the problems and costs involved. The design parameters and the tradeoffs that are available in the consideration of these questions are evaluated. Some of the more serious limitations pertain to: (1) the presence of ground clutter and F region auroral clutter; (2) available average power; (3) weight and volume associated with required antenna size, transmitter, and energy storage devices; and (4) antenna breakdown associated with high power transmitter problems. Author

N77-10401# Communications Research Centre, Ottawa (Ontario). Dept. of Communications.
HIGH FREQUENCY RADIO NOISE SURVEY AT THREE COMMUNICATION SITES IN THE OTTAWA AREA
W. R. Lauber, L. R. Bode, and J. M. Bertrand Aug. 1976 33 p refs
(CRC-1294) Avail: NTIS HC A03/MF A01

Radio noise measurements have been carried out over two week periods during each of the four seasons to establish existing day time noise levels at three high frequency communication sites in the Ottawa area. The parameters used were the average available noise power spectral density, and the ratio of the rms to the average voltage of the noise envelope. By comparing the results to those expected at a quiet receiving site it has been possible to rate quantitatively the site effectiveness or degree of degradation of each site. As well, noise measurements have been made in the evenings at one site. By using these night time values as representative of the Ottawa area, the day-night difference in noise levels at 2.5 MHz was computed. These differences were also used to rate quantitatively the degree of degradation of each site. Author

N77-10402# Technische Hochschule, Darmstadt (West Germany). Fachgebiet Uebertragungstechnik.
PITCH PERIOD SYNCHRONOUS FAST FOURIER TRANSFORMATION OF SPEECH SIGNALS [GRUNDPERIODENSYNCHRONE FAST-FOURIER-TRANSFORMATION VON SPRACHSIGNALEN]
Ruediger Reiss Jun. 1975 34 p refs In GERMAN
(IND-FB-79) Avail: NTIS HC A03/MF A01

Four methods of adapting FFT frame lengths for segmentation synchronous to the speech pitch period were investigated to determine their effect on the determination of human voice pole frequencies from the maxima of the transient spectrum amplitudes. These are: adaptive sampling at sampling frequency adapted to pitch period duration, reduction of the pitch period synchronous segment, extension of the pitch period synchronous signal extract by adding zeroes, and extension of the pitch period synchronous segments by overlapping. The first two methods were found to be effective. ESA

N77-10403# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
COMPARATIVE INVESTIGATION OF A NUMBER OF FIELD TELEPHONES AND FIELD TELEPHONE EXCHANGES
H. J. M. Steeneken, H. vanDam, and H. Schuffel 1975 13 p In DUTCH; ENGLISH summary
(Contract A75/KL/044)
(IZF-1975-8; TDCK-66700) Avail: NTIS HC A02/MF A01

The speech intelligibility and ergonomic aspects of a number of field telephones and field telephone exchanges were investigated. Only minor differences in speech quality were found. The operation comfort, on the contrary, showed considerable differences. Author (ESA)

N77-10404# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
SPEECH INTELLIGIBILITY VIA RADIO EQUIPMENT, PART 3
H. J. M. Steeneken and T. Houtgast 1975 13 p In DUTCH; ENGLISH summary
(Contract A71/KL/023)
(IZF-1975-10-Pt-3; TDCK-66827) Avail: NTIS HC A02/MF A01

The efficiency of the low frequency signal processing with respect to speech intelligibility was measured for the VHF-FM communication sets KL/VRC-3600 and SSB equipment KL/GRC 4394. Results show a good agreement with previously published data on the optimal properties of communication equipment. Author (ESA)

N77-10405# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
A PHYSICAL METHOD FOR MEASURING THE QUALITY OF TELEPHONES AND MICROPHONES
H. J. M. Steeneken and T. Houtgast 1976 18 p refs In DUTCH; ENGLISH summary
(Contract A72/KL/04)
(IZF-1976-1; TDCK-67317) Avail: NTIS HC A02/MF A01

A physical method for measuring the quality of speech transmission channels was adapted to include the effect of microphones and telephones. The method is based on the intensity fluctuations of running speech. The decrease of these fluctuations due to disturbances can be expressed by a single index. It is shown that, also for channels including a microphone and a telephone, this index correlates well with the scores from intelligibility tests with talkers and listeners. Author (ESA)

N77-10406# Technical Univ. of Denmark, Lyngby. Inst. of Electromagnetics.
ANALYSIS OF 13.5 - 15 GHz AMPLITUDE AND PHASE PROPAGATION DATA
G. Mogensen Apr. 1975 12 p refs Presented at the Intern. Symp. on Probl. of Space- and Terrest. Microwave Propagation, Graz, 1975
(TUD-D-248) Avail: NTIS HC A02/MF A01

Data from a swept propagation experiment collected since June 1974 to obtain improved knowledge on propagation conditions (e.g. multipath and precipitation) which impair the quality of line of sight microwave links are analyzed. Distribution functions of noise in the FDM-FM system are estimated. The data collected during the propagation experiment can be used to evaluate the reliability of a broadband PCM link by a computer simulation based on the propagation data and a model of the PCM transmission equipment. It is concluded that the results of the analyses carried out on different modulation systems may give appropriate information to select the one most suitable to optimize the amount of reliable traffic transmitted within the available frequency bands. ESA

N77-10407# Technical Univ. of Denmark, Lyngby. Inst. of Electromagnetics.
PROGRAMS FOR COMPUTATION OF MATHIEU FUNCTIONS
Tove Larsen Mar. 1975 43 p refs
(TUD-S-265; TUD-R-137) Avail: NTIS HC A03/MF A01

A number of subroutines written in FORTRAN 4 to compute ordinary and modified Mathieu functions are described. A simpler and less accurate program for the computation of ordinary Mathieu functions is included. The programs were written for use in connection with investigations on waveguides with elliptical cross sections. ESA

N77-10408# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
ON THE INTERESTS OF NUMERICAL TRANSMISSION OF NUMERICAL SIGNALS IN A DATA PROCESSING SYSTEM. ATTEMPTS TOWARDS A MODULAR COMPUTING DEVICE [CONSIDERATIONS SUR L'INTERET D'UNE TRANSMISSION SERIE DES VALEURS NUMERIQUES DANS UNE CHAINE DE TRAITEMENT DU SIGNAL. EBAUCHE D'UN ENSEMBLE DE CALCUL MODULAIRE UTILISANT CETTE TRANSMISSION]

J. Lienard 10 Oct. 1975 20 p refs In FRENCH
(CEPHAG-42/75) Avail: NTIS HC A02/MF A01

The interest in defining a unified data transmission system between instruments and using serial streams of numerical data is detailed with regard to simplification at intercommunication level. A set of modules to implement the basic principles is proposed showing that with simple wiring the main processing features needed for signal processing can be performed. ESA

N77-10409# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.

REPRESENTATION OF SIGNALS [REPRESENTATION DES SIGNAUX]

G. Jourdain 23 Oct. 1975 42 p refs In FRENCH
(CEPHAG-44/75) Avail: NTIS HC A03/MF A01

The representation of deterministic signals is dealt with starting from the signal space considered as a vectorial space. Various representations are discussed including discretization through orthogonal complete bases and continuous representations with emphasis on the Fourier transform. For random signals the linear filtering is detailed, and the Karhunen-Loeve expansion is discussed. The fundamental functionals related to representation of signals in the conjugate spaces of time and frequency are discussed with regard to the product of useful duration times useful bandwidth, degrees of freedom of a slice of duration T for a band limited signal, and the ambiguity function of the signal. ESA

N77-10410# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.

NUMERICAL SIMULATION OF THE EXISTENCE TEST FOR THE DIFFUSION FUNCTION IN A VARIABLE PARAMETER MEDIUM [SIMULATION NUMERIQUE DU TEST D'EXISTENCE DE LA FONCTION DE DIFFUSION D'UN MILIEU A PARAMETRES VARIABLES]

P. Ningre and G. Jourdain 28 Nov. 1975 110 p refs In FRENCH
(CEPHAG-51/75) Avail: NTIS HC A06/MF A01

A model of a filter with variable parameters excited by monochromatic waves is described. Two kinds of media are considered: the Wide Sense Stationary (WSS) and WSS with the addition of no correlation termed WSSUS. The existence or not of a diffusion function may be tested by following the time evolution of the mean value of the output power or input power as a function of frequency. The theoretical properties of the impulse response of the filter are detailed together with the estimators used. The results of computations to the second order for WSS and WSSUS media are discussed together with the interaction between two frequencies in each of these media. An application to marine environments is proposed. ESA

N77-10411# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.

SIGNAL ANALYSIS IN A TIME-FREQUENCY REPRESENTATION [REPRESENTATION CONJOINTE DES SIGNAUX. REPRESENTATION TEMPS-FREQUENCE]

B. Escudie 21 Nov. 1975 38 p refs In FRENCH
(CEPHAG-52/75) Avail: NTIS HC A03/MF

The concept of a joint time-frequency representation of a signal is developed. It is shown to overcome the limitations due to time analysis or frequency analysis of a signal. To be valid the joint representation must be associated to a localization operator in the time frequency plane and the energy carried out by the signal must be finite. The physical meaning of the representation is shown to be related to the variation of the energetic flux in an elementary cell of the time-frequency plane. It is also related to the ambiguity function of Woodward. For deeply modulated signals the representation gives the envelope and the signal instantaneous frequency simultaneously. The generalization to random stationary processes presents some difficulties. ESA

N77-10412# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.

DETECTION IN THE PRESENCE OF REVERBERATION [DETECTION EN PRESENCE DE REVERBERATION]

G. Jourdain 16 Jan. 1975 44 p refs In FRENCH
(CEPHAG-1/75) Avail: NTIS HC A03/MF A01

The problem of detecting a known or unknown signal in the presence of nonstanding Gaussian noise was considered. An added constraint is that the noise partly originates from reverberation of the emission signal. The optimum receiver structure was established, and the influence of the statistical properties of the reverberating medium on the receptor performance is discussed together with a detailed analysis of the emission signal shape. The possibility of a simple implementation of the receptor in specified cases was investigated leading to a suboptimal system in most situations. ESA

N77-10413# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.

FREQUENCY CODES GENERATOR [GENERATEUR DE CODES FREQUENTIELS]

J. P. Henrioux, A. Silvent, G. Revol, and D. Mathieu 23 Dec. 1974 75 p refs In FRENCH
(Contract DRME-73/34)
(CEPHAG-2/75) Avail: NTIS HC A04/MF A01

A frequency synthesizer allowing for simultaneous emission of a train series of monochromatic signals regularly spaced on the frequency axis is presented. Two groups of frequencies, separately tunable, can be emitted. The emission duration can be limited by a gate or can be permanent. The phases of the signals are generated numerically and the amplitudes of the sines come from a dead memory table. The output signal is the summation of the elementary signals some of which may be suppressed via a programmable coding. The technical implementation is detailed. ESA

N77-10414# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.

LONG DISTANCE ACOUSTIC COMMUNICATION BETWEEN A SHORE STATION AND A SUBMARINE IN DEEP IMMERSION Final Report [COMMUNICATION SONORE A LONGUE DISTANCE ENTRE UNE STATION FIXE ET UN SOUS MARIN EN IMMERSION PROFONDE]

J. Y. Jourdain, W. Kofman, and J. P. Henrioux 30 Apr. 1975 96 p refs In FRENCH
(Contract DRME-73/34)
(CEPHAG-20/75) Avail: NTIS HC A05/MF A01

Various models for the marine environment are reviewed, and a discussion shows that a Rayleigh model is convenient. The feasibility of a reliable information transmission system was demonstrated. A signal synthesizer was constructed during actual measurements. The data processing methods and results are detailed, and the conclusions show that at 100 nm a link at 110 bps maximum is achievable. ESA

N77-10415# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.

A STUDY OF ULF WAVES BETWEEN CONJUGATE POINTS [ETUDE DES ONDES U.B.F. ENTRE POINTS CONJUGUES]

F. Glangeaud and J. L. Lacoume 3 Jun. 1975 61 p refs In FRENCH; ENGLISH summary Submitted for publication
(CEPHAG-27/75) Avail: NTIS HC A04/MF A01

The observations taken in the conjugate points having a 500 km distance, allow precising the conditions in which the Pc1 characteristics are identical between conjugate points and determining if this effect is limited only at these points. The first statistical study makes it possible to determine the respective influences of the ionosphere and the conditions of the Pc1 emission on the number of the observed cases and their amplitude distribution function; the form of the occurrence curves can be predicted. In addition a comparative study between the different levels and the forms of the amplitude spectral densities clarifies the absorption amount orders of the ionosphere and the propagation effect in the magnetosphere. The study of a particular case shows that, if it is possible to find mean effects, the variance of the results has an important value. Author (ESA)

N77-10416# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.

[RESEARCH ACTIVITIES OF THE STUDY CENTER OF ALEATORY AND GEOPHYSICAL PHENOMENA] Semiannual Report, 1975 [RAPPORT D'ACTIVITE 1ER SEMESTRE 1975]

J. L. Lacoume 24 Nov. 1975 12 p In FRENCH

(CEPHAG-53/75) Avail: NTIS HC A02/MF A01

The characterization of a marine channel is dealt with on a theoretical basis with regard to optimal processing for active detection with reverberation and by simulations including the diffuse echo method, tank method, and computerized method. The signal processing activity concentrated on estimating correlation functions in real time in the time and spectral domain. A software was written to apply CEPSTRUM transforms to digital signals with application to marine environments. Signal synthesis of Doppler-tolerant discrete signals and their detection in noise was pursued by the coherent processing method. A frequency code generator with phase encoding, an onboard correlator, and an unfoldable polygonal antenna were built. Signal characterization and antenna processing by algorithms for acoustical imagery were carried out. A meeting was held on possible involvement of CEPHAG in magnetic signal detection. ESA

N77-10417# European Space Agency, Paris (France).
ON THE MODULATION OF HIGH-FREQUENCY SATELLITE SIGNALS BY HYDROMAGNETIC WAVES
Klaus Riebold Sep. 1976 144 p refs Transl. into ENGLISH of 'Ueber die Modulation hochfrequenter Satellitensignale durch hydromagnetische Wellen', DFVLR, Oberpfaffenhofen, West Ger. Report DLR-FB-76-15, 16 Feb. 1976 Original German report available from DFVLR, Cologne DM 51
(ESA-TT-315; DLR-FB-76-15) Avail: NTIS HC A07/MF A01

The propagation of high-frequency electromagnetic waves in a periodically disturbed ionosphere is discussed. The disturbances are supposed to be hydromagnetic waves of an extremely low frequency that give rise to magnetic micropulsations. The hydromagnetic waves are treated by means of Maxwell's equations and the equations for the medium. The equations for the high-frequency wave propagation now contain interaction terms due to the low-frequency disturbances. The result is a modulation of the high-frequency waves. Analytical and numerical examples show that it is essentially a phase modulation that affects the field components of the high-frequency wave. A weak amplitude modulation is also obtained. Author (ESA)

N77-10418# Picatinny Arsenal, Dover, N.J.
TELEMETRY INSTRUMENTATION FOR ACCELERATION TRACK TEST SYSTEM
Murray Rosenbluth Apr. 1976 24 p refs
(AD-A024644; PA-TR-4916) Avail: NTIS HC A02/MF A01 CSCL 09/6

A special purpose telemetry system was developed to transmit data from a test vehicle moving on a mostly enclosed multiple curved track. The test vehicle contained a multipole switch, whose contacts were actuated at different acceleration levels. Acceleration profile wave shape and switch closure information was transmitted to a telemetry receiving station from the track (total length 110 ft 33.5 m) by means of a magnetic field coupler. Problems encountered during the design of the magnetic field coupler and telemetry system are discussed. An analog simulation of a noise problem encountered during the testing phase is also described. The results of the simulation are used to aid in the solution of the problem. Author (GRA)

N77-10419# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
A SYNCHRONOUS SIGNAL PROCESSING TECHNIQUE FOR REPETITIVE ARBITRARY WAVEFORMS Instrumentation Papers
Floyd H. Cook and Randall E. Murphy 19 Jan. 1976 19 p refs
(AF Proj. 8658)
(AD-A024000; AFCRL-IP-245; AFCRL-TR-76-0035) Avail: NTIS HC A02/MF A01 CSCL 09/4

The details of a new signal processing technique have been discussed, an instrument (Time Resolver Electronics) constructed, and the performance compared with a conventional lock-in amplifier. The principal advantages include increased S/N and elimination of distortion caused by the temporal variation of the signal waveform. It has been shown that as the signal waveform departs from the sine wave, the efficiency of the new technique becomes superior to that used in commercial instruments. Even more dramatic is the demonstrated elimination of distortion due to waveform character, repetition rate, and duty cycle. Although we have chosen only one example to illustrate the capabilities of the new technique, there are a number of areas of possible application. These include the molecular beam area, pulsed laser excitation, and studies of excitation-relaxation phenomena in general. In fact, any application that presently requires a lock-in amplifier for signal processing could be a possible candidate to utilize the new technique to advantage. Author (GRA)

N77-10420# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
PRIVATE LINE INTERFACE DEVELOPMENT. PACKET NETWORK SECURITY. PACKET BROADCAST BY SATELLITE Combined Quarterly Technical Report, Jan. - Apr. 1976
D. C. Walden May 1976 30 p ref
(Contract MDA903-76-C-0213; ARPA Order 3173)
(AD-A024538; BBN-3301; CQTR-1) Avail: NTIS HC A03/MF A01 CSCL 17/2

This Quarterly Technical Report describes work on the development of a Private Line Interface, on end-to-end packet network security, and on the development of an experimentation with packet broadcast by satellite. Author (GRA)

N77-10421# Optelecom, Inc., Gaithersburg, Md.
OUT OF LINE OF SIGHT MISSILE LINK Final Report
Apr. 1976 52 p
(Contract DAAH01-75-C-0414)
(AD-A024569) Avail: NTIS HC A04/MF A01 CSCL 17/2

This report describes development aimed at producing an optical fiber communication link between a missile and its launch point for transmission of TV data from the missile to the launch point and command signals in the reverse direction. Optical fibers having a loss of 30 db/km were fabricated that were paid out from a spool at speeds of greater than 300 ft/sec GRA

N77-10422# Naval Electronics Lab. Center, San Diego, Calif.
ACOUSTIC NOISE REDUCTION WITHIN THE ASW SUPPORT COMMUNICATIONS MODULES OF THE TACTICAL SUPPORT CENTER (ASCOMM/TSC) Research and Development Report, Jul. 1975 - Feb. 1976
Elaine Schiller and R. Paul Kaufman 30 Mar. 1976 32 p
(NELC Proj. N306)
(AD-A023674; NELC/TR-1983) Avail: NTIS HC A03/MF A01 CSCL 17/2

The ASW Support Communications (ASCOMM) portion of the Tactical Support Center (TSC) provides communication terminals during ASW aircraft missions for voice, teletype, and data transmissions in Uhf, hf, and FLTSATCOM modes, both clear and encrypted. ASCOMM equipment consists of crypto equipment, remote controls, modems, patch panels, communications console, teletypes, teleprinters, reperforators, tape punches, and air conditioners. A sound survey at Naval Air Facility, Sigonella, Sicily, resulted in the NELC task reported here to reduce the ASCOMM noise level at all mobile ASCOMM/TSCs worldwide. NELC determined the sources and the extent of the noise problem, identified the system constraints, and designed and built equipment to minimize the noise problem with minimum interference to system operation. The equipment will be installed at NAF, Sigonella (the site which originally reported the problem) in July 1976, and before and after operational equal-level noise contours will be obtained. GRA

N77-10423# Armed Forces Communications and Electronics Association, Eatontown, N. J.
PROCEEDINGS OF THE FIRST ANNUAL SEMINAR: THE ART OF COMMUNICATIONS INTERFACES
Seymour Krevsky 22 Apr. 1976 101 p refs Conf. held at Fort Monmouth, N. J., 22 Apr. 1976
(AD-A023907; AFCEA-FM-1) Avail: NTIS HC A06/MF A01 CSCL 17/2

Both the oldest and the newest problem areas in communications electronics interfaces are discussed in conjunction with the currently critical digital communication system evolution. The oldest interface problem, still the most essential is the man machine communications interfaces. The newest is the burgeoning field of optical waveguide--fibre optics communications. A total of eleven technical papers are presented. GRA

N77-10424# Illinois Univ., Urbana. Aviation Research Lab.
APPARENT MOTION QUALITY AND TARGET DETECTION ON A VISUALLY TIME-COMPRESSED DISPLAY
Lawrence Allen Scanlan Nov. 1975 103 p refs
(Contract F44620-70-C-0105; AF Proj. 9778)
(AD-A024360; ARL-75-16/AFOSR-75-6) Avail: NTIS HC A06/MF A01 CSCL 17/9

Explanations of the superior target detection performance with visually time-compressed radar displays have involved the assumption that the coherent motion of the target against the random motion of background noise facilitates detection, much as the blossoming of a flower is made apparent by time-lapse photography. From the appearance of the display, this assumption seems reasonable; however, experimental findings are not fully explained in terms of apparent motion. The equivocal nature of the relationship between visually apparent motion and target detection on a time-compressed display prompted an investigation of four spatial and temporal display variables using a central-composite response surface experimental design. Subjects performed three tasks: target detection and two ratings of apparent target motion quality, with random noise dots present and absent. Target detection performance was highly correlated with the scale of motion quality resulting from ratings with noise present but less highly correlated with ratings of target motion quality with noise absent. Nearly all of the variance in motion quality ratings, both with and without noise present, was accounted for by the regression equations derived from the extremely economical data sampling strategy afforded by the central-composite design. GRA

N77-10425# Armament Development and Test Center, Eglin AFB, Fla.
DEVELOPMENT OF AN IMPROVED RADAR AUGMENTATION SYSTEM FOR THE BQM-34A TARGET DRONE, VOLUME 1 Final Report
C. J. Bishoff Jan. 1976 659 p refs
(AD-A023961; ADTC-TR-75-64-Vol-1) Avail: NTIS HC A99/MF A01 CSCL 17/9

Data were acquired to define the radar cross section characteristics of the BQM-34A target drone equipped with an active radar augmentation system. The program resulted in an improved augmentation system for the BQM-34A target drone. Development of the improved I-Band augmentation system required the location and testing of a number of different antenna combinations and locations. After the determination of optimum antenna systems performance, radar cross section measurements were obtained on the augmented BQM-34A Drone. GRA

N77-10426# Washington Univ., Seattle. Dept. of Electrical Engineering.
RESOLUTION AND ERROR LIMITS IN SYNTHETIC APERTURE RADAR SYSTEMS
Robert Francois, Jr. and F. Paul Carlson Jun. 1975 84 p refs
(Contract N00014-67-A-0103-0024; NR Proj. 350-005)
(AD-A024433; UW-TR-189) Avail: NTIS HC A05/MF A01 CSCL 17/9

The purpose of this report is to estimate the best case resolution capability of a synthetic aperture radar system when the data is reduced in a coherent optical processor. The cross track or range resolution is provided by standard pulse echo timing. The along track or azimuth resolution is provided by the synthetic aperture created in that dimension. It is shown that the processor may introduce a coupling of azimuth and range information. Through judicious choice of system parameters this coupling may be minimized and azimuth resolution improved. Of particular interest is the result that, when present, this coupling may be reduced by reducing the angular beamwidth of the transmitting/receiving aperture. This shortens the synthetic aperture and thus violates the intuitive feeling that resolution should always be improved with increased aperture size.
Author (GRA)

N77-10427# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
RADAR FOLIAGE PENETRATION MEASUREMENTS AT MILLIMETER WAVELENGTHS Final Report, 30 Jun. - 31 Dec. 1975
N. C. Currie, E. E. Martin, and F. B. Dyer 31 Dec. 1975 73 p refs
(Contract DAAA25-73-C-0256; GIT Proj. 1485-100)
(AD-A023838; GIT-A-1485-TR-4) Avail: NTIS HC A04/MF A01 CSCL 17/9

A series of radar measurements on the penetration of foliage has been made at 9.4, 16.2, 35, and 95 GHz. Measurements were made for both the one-way and two-way cases at 9.4 and 16.4 GHz at similar foliage areas for comparison. Most of the measurements were made at depression angles 3 degrees, although a set of one-way measurements was made at 9.4 and 16.2 GHz for a depression angle of 29 degrees. Attenuation properties, polarization ratios, and noncoherent spectral correlation properties were investigated as a function of frequency, polarization, depth of foliage and wind speed. Limited comparisons are made with data previously available at lower frequencies.
GRA

N77-10099*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMAND DETECTOR SNR ESTIMATOR AND LOCK STATUS MONITOR CIRCUITRY
R. F. Emerson *In its* The Deep Space Network 15 Oct. 1976 p 42-51 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

N77-10106*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADIO FREQUENCY BORESIGHT ANALYSIS OF THE LOW COST 64-METER ANTENNA
M. S. Katow *In its* The Deep Space Network 15 Oct. 1976 p 128-135 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 17B

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N77-10428* National Aeronautics and Space Administration. Pasadena Office, Calif.
THE dc-TO-dc CONVERTERS EMPLOYING STAGGERED-PHASE POWER SWITCHES WITH TWO-LOOP CONTROL Patent
Gene W. Wester, inventor (to NASA) (JPL) Issued 5 Oct. 1976 7 p Filed 17 Dec. 1974 Supersedes N75-15876 (13 - 07, p 0764) Published under the second Trial Voluntary Protest Program as B 533 734, 27 Jan. 1976 Sponsored by NASA
(NASA-Case-NPO-13512-1; US-Patent-3,984,799; US-Patent-Appl-SN-533734; US-Patent-Class-321-2; US-Patent-Class-321-19; US-Patent-Class-323-17; US-Patent-Class-323-22T; US-Patent-Class-323-23; US-Patent-Class-323-DIG.1) Avail: US Patent Office CSCL 09C

A switched inductor voltage is coupled to a sense winding in each phase, and all sense windings are connected in series to one of two feedback loops to provide a signal that indicates when one of the power switches is on as the principal determinant of switching instants. A sequencer is triggered each time a pulse generator is triggered to turn on a different power switch in sequence at each switching instant.
Official Gazette of the U.S. Patent Office

N77-10429* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METHOD AND APPARATUS FOR NEUTRALIZING POTENTIALS INDUCED ON SPACECRAFT SURFACES Patent
Robert E. Hunter, inventor (to NASA) Issued 5 Oct. 1976 6 p Filed 11 Jul. 1975 Supersedes N75-27265 (13 - 18, p 2239)
(NASA-Case-GSC-11963-1; US-Patent-3,984,730; US-Patent-Appl-SN-595197; US-Patent-Class-317-2D;

US-Patent-Class-244-1A; US-Patent-Class-244-42CG; US-Patent-Class-324-72) Avail: US Patent Office CSCL 09C

A potential induced on the surface of an orbiting spacecraft is neutralized to the potential of a plasma through which the spacecraft is traveling by directing charged particles into the plasma from the spacecraft surface. The induced potential occurs in response to bombardment of the spacecraft surface by ambient charged particles which may be negative or positive. The charged particles directed into the plasma from the surface have the same polarity as the induced potential to provide the neutralization. The invention can be utilized to maintain different, electrically isolated segments of a spacecraft surface at the same potential to prevent electric discharges between the different parts and thereby protect electric circuits within the spacecraft.

Official Gazette of the U.S. Patent Office

N77-10430 British Broadcasting Corp., Kingswood (England). Engineering Div.

PERFORMANCE TESTS ON A SELECTION OF 100-ELEMENT CHARGE-COUPLED DEVICES

G. M. LeCouteur Aug. 1976 24 p refs

(BBC-RD-1976/23) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

A number of samples of a 100 element charge coupled device (CCD) were tested under conditions relevant to the potential use of CCD's for solid stage image-sensing, storage, and signal processing at video frequencies. Although the particular devices tested had no foreseeable practical application in these areas, the information gained should be useful to the manufacturers in clarifying how this technology will need to be developed in order to produce products of real value to the broadcaster in the future. Author

N77-10431# Georgia Inst. of Tech., Atlanta.

FEDERAL AVIATION ADMINISTRATION: GEORGIA INSTITUTE OF TECHNOLOGY WORKSHOP ON GROUNDING, BONDING AND SHIELDING Final Report, 27-29 Apr. 1976

May 1976 260 p refs

(Contract DOT-FA72WA-2850)

(AD-A027362/3; FAA-RD-76-104) Avail: NTIS HC A12/MF A01 CSCL 09/3

A state-of-the-art review and background research reveals a significant divergence of opinion as to the preferred techniques of grounding of electronic equipment and systems. There exists an absence of agreement on a unified approach to grounding which is applicable to all frequency ranges and signal types. A workshop was conducted which brought together distinguished experts in the fields of grounding, lightning and electromagnetic compatibility. Author

N77-10432*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

LINEAR REGULATOR DESIGN FOR STOCHASTIC SYSTEMS BY A MULTIPLE TIME SCALES METHOD

Demosthenis Teneketzis and Nils R. Sandell, Jr. [1976] 19 p refs

(Grants NGL-22-009-124; E(49-18)-2087)

(NASA-CR-149099) Avail: NTIS HC A02/MF A01 CSCL 09A

A hierarchically-structured, suboptimal controller for a linear stochastic system composed of fast and slow subsystems is considered. The controller is optimal in the limit as the separation of time scales of the subsystems becomes infinite. The methodology is illustrated by design of a controller to suppress the phugoid and short period modes of the longitudinal dynamics of the F-8 aircraft. Author

N77-10433*# University of South Florida, Tampa. Dept. of Electrical Engineering.

ELECTRICAL PROPERTIES OF EPOXIES AND FILM RESISTORS Interim Report

Jerry E. Sergent Mar. 1976 24 p

(Contract NAS8-31172)

(NASA-CR-149980) Avail: NTIS HC A02/MF A01 CSCL 09A

The reliability of hybrid microcircuits has been enhanced in recent years by the use of organic adhesives as a replacement for solder and eutectics. The epoxies have been the most effective and widely used material for this application. Methods for measuring the electrical and mechanical properties of epoxies are developed. Data are given for selected conductive adhesives at high and low frequencies. The temperature coefficients of resistance of thick film resistors are presented. Author

N77-10434*# Kanner (Leo) Associates, Redwood City, Calif.

CHANGE IN ELECTRICAL RESISTANCE OF THIN METAL LAYERS CAUSED BY GAS ADSORPTION

P. Wissmann Washington NASA Oct. 1976 12 p refs Transl. into ENGLISH of Z. fuer Physik. Chem. Neue Folge (West Ger.), v. 71, 1970 p 294-302

(Contract NASw-2790)

(NASA-TT-F-17304) Avail: NTIS HC A02/MF A01 CSCL 09C

When gas is adsorbed onto thin metal films, electrical resistance increases. The thinner the film, the greater the resistance. A decrease in the free conduction electrons of the film or a reduction in the effective thickness of the film will not explain this effect. The adsorbed molecules are thought to act as dispersion centers for the conduction electrons, in a manner similar to foreign atoms alloyed into the metal. Author

N77-10435*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL PERFORMANCE OF A SMALL SIZE TWO STAGE DEPRESSED COLLECTOR FOR A 4.8-9.6 GHz HIGH PERFORMANCE TWT Interim Report, Apr. 1975 - Jun. 1976

P. Ramins and T. Fox Sep. 1976 25 p refs Prepared in cooperation with Aeronaut. Systems Div., Wright-Patterson AFB Ohio

(NASA-TM-X-73513; E-8920) Avail: NTIS HC A02/MF A01 CSCL 09A

Three simple small size two stage depressed collectors were designed and experimentally evaluated in conjunction with a 330 to 520 watt CW, 4.8 to 9.6 GHz traveling wave tube (TWT). Each of the three designs produced a minimum collector efficiency of 80.0 percent considering saturated TWT operation at the maximum of output frequency and at band edges. The highest minimum collector efficiency produced was 80.5 percent with a two stage depressed collector of 4.8 cm diameter by 7 cm high internal dimensions. Author

N77-10436# Sandia Labs., Albuquerque, N.Mex.

SSWL AND BWL: FINITE ELEMENT MODELS OF COMPRESSED MAGNETIC FIELD CURRENT GENERATORS

T. J. Tucker and J. E. Leeman Jan. 1976 82 p refs

(Contract AT(29-1)-789)

(SAND-75-0604) Avail: NTIS HC A05/MF A01

Documentation is presented for two computer codes modeling the behavior of compressed magnetic field current generators. Code output results for the typical generator configurations are presented and compared to experimental results. Author (ERA)

N77-10437# Ames Lab., Iowa.

COMPUTER CONTROLLED DATA MEASUREMENT AND ANALYSIS SYSTEM USED FOR MEASURING SWITCHING PARAMETERS OF SEMICONDUCTORS

C. H. Culp and D. E. Eckels Jan. 1976 197 p

(Contract W-7405-eng-82)

(IS-3691) Avail: NTIS HC A09/MF A01

A computer-controlled data acquisition system which was employed to measure the threshold switching parameters of amorphous semiconductors is described. This system is capable of measuring the delay time required for a sample to switch, the electrical energy put into a sample and the charge passing through it during the delay time, and its ambient temperature. With this equipment an experimenter is able to control the magnitude and maximum duration of the voltage applied to a sample, the time interval between applications of voltage, and the load resistor in series with a sample. An HP 2114B minicomputer provides control and analysis capabilities for this system. Basically, this apparatus is a constant voltage pulse generator and signal processor. Major modules of this system are a transistorized high voltage switch, a digitally controlled high voltage resistor and power supply, a low-thermal-noise

input-scanner, a precision timer, and two analog integrators.
Author (ERA)

N77-10438# Sandia Labs., Albuquerque, N.Mex.
CHARACTERIZATION OF THE THERMOSONIC WIRE BONDING TECHNIQUE
D. R. Johnson and E. L. Chavez Jan. 1976 27 p refs
(Contract AT(29-1)-789)
(SAND-74-0411) Avail: NTIS HC A03/MF A01

A combination of ultrasonic energy and thermocompression techniques was evaluated with regard to the bond response of thin film substrate metallization and thick film discrete component terminations for microcircuits. The object was to determine not only the quality of thermosonic gold wire bonds and the performance of these bonds when subjected to thermal environmental tests, but also to determine the process control parameters necessary to produce repeatable, reliable bonds. Comparison was made throughout the study with regard to results previously achieved on the same metallization systems using standard fine wire thermocompression bonding techniques. It is concluded that the thermosonic wire bonding technique offered the advantages of lower bonding forces and lower substrate temperatures compared to the thermocompression process. In addition, it is shown that the thermosonic technique eliminates the need for special pre-bond etching and cleaning procedures presently used r production of Sandia hybrid microcircuits. Author (ERA)

N77-10439# Technische Hochschule, Darmstadt (West Germany). Fachgebiet Uebertragungstechnik.
MATRIX DESCRIPTION AND ANALYSIS OF TIME-DISCRETE SYSTEMS [MATRIXBESCHREIBUNG UND ANALYSE ZEITDISKRETER SYSTEME]
Raimund Luecker Jan. 1976 38 p refs In GERMAN
(IND-FB-81) Avail: NTIS HC A03/MF A01

A matrix description of time-discrete systems was derived from the signal flow graph theory. Based on this, a method was developed to calculate the external behavior of such networks. The system consists of non retroactive multipliers, multiple adders, and delay circuits. ESA

N77-10440# Technische Hochschule, Darmstadt (West Germany). Fachgebiet Uebertragungstechnik.
SYNTHESIS OF TIME-DISCRETE SYSTEMS [SYNTHESE ZEITDISKRETER SYSTEME]
Raimund Luecker Jan. 1976 21 p refs In GERMAN
(IND-FB-82) Avail: NTIS HC A02/MF A01

A method for synthesis of time discrete systems is described, based on the stepwise introduction of internal parameters in a given description of the external system behavior. The method is not limited to the dimensioning of a given structure: the final circuit configuration remains variable up to the last step of synthesis. A great number of degrees of freedom allows many variation possibilities and the synthesis of new structures. Examples are given for the synthesis of a second degree bandpass filter, lowpass filter, and allpass (equalizer) filter, as well as a three-port parallel adapter. ESA

N77-10441# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
COMMUTATION FILTER [FILTRE A COMMUTATION]
A. Silvent and D. Mathieu 19 Feb. 1975 64 p refs In FRENCH
(CEPHAG-5/75) Avail: NTIS HC A04/MF A01

A shunt commutation filter is described with regard to general theory and performances in analog or digital embodiment. The high selectivity and the proportionality of the tuning frequency to a pilot frequency were demonstrated. Tests performed on an analog embodiment show that the implementation is not critical and that the tuning frequency may easily be modified without action on the passive components; hence the stability is essentially a function of the clock stability. ESA

N77-10442# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
RECOVERY OF COMPONENTS OF THE SEMICONDUCTOR TYPES [RECUPERATION DE COMPOSANTS DU TYPE SEMI-CONDUCTEURS]
J. Denis and J. J. Lefebvre 21 Nov. 1975 20 p In FRENCH
(LRBA-E-440-NT-11/SYE) Avail: NTIS HC A02/MF A01

The problem of recovering about 50.000 semiconductors on 2,000 printed circuits was solved. Two methods were specifically studied: first, heating the component soldering points in an Sn liquid bath and extraction using a special tool and, second, HF real heating with manual extraction using the same tool. The results of both methods proved satisfactory. Details are given on the experimental setup and the extraction tool, including construction drawings. ESA

N77-10443# European Space Agency, Paris (France). Space Documentation Service.
ESA ELECTRONIC COMPONENT DATABANK: PASSIVE COMPONENT REFERENCE BOOK (RESISTORS, CAPACITORS, RELAYS, INDUCTORS)
1976 498 p In ENGLISH and FRENCH
(ESA-ECDB-2) Avail: NTIS HC A21/MF A01

Basic reference data on resistors, capacitors, relays, and inductors are presented, including the following data: physical and electrical characteristics, manufacturer, model designation, and dimensions. ESA

N77-10444# European Space Research and Technology Center, Noordwijk (Netherlands). Product Assurance Div.
GUIDELINES FOR THE QUALIFICATION OF SOLDERLESS/MECHANICAL ELECTRICAL INTERCONNECTION TECHNIQUES
Paris ESA 1 Dec. 1975 11 p
(ESA-PSS-22/QRM-15T-ESTEC-Iss-1) Avail: NTIS HC A02/MF A01

Environmental effects that may degrade spacecraft electrical interconnections are reviewed. The ESA policy is that metallurgically joined connections are to be preferred (particularly soldered joints). Solderless or mechanical electrical connection techniques intended for use on ESA spacecraft must be initially qualified according to a qualification-test program specification. Guidelines for such a specification are summarized.Author (ESA)

N77-10445# European Space Research and Technology Center, Noordwijk (Netherlands). Product Assurance Div.
SPECIFICATION OF HYBRID MICROCIRCUITS FOR USE ON EUROPEAN SPACE PROJECTS
Shimon E. David and Albert R. Granier [1975] 12 p refs
Avail: NTIS HC A02/MF A01

In order to qualify thin and thick film hybrids for use on spacecraft, specifications were written applying the line certification concept. A manufacturer is surveyed and then has to demonstrate by designing and producing test structures and testing them that the processes and materials employed are acceptable. The line certification is followed by qualification of the line and each circuit type. This procedure is presently being applied to various manufacturers (thin and thick film) in Europe. Some of the problems encountered and solutions found are also described. Author (ESA)

N77-10446# European Space Agency, Paris (France).
THE ACCEPTANCE TESTS ON THE ANTENNA AND PEDESTAL OF THE HELIOS COMMAND STATION
Peter Sliwinski et al Apr. 1976 67 p refs Transl. into ENGLISH of 'Abnahmemessungen an der Antenne u. dem Drehstand der Helios- Kommandostation', DFVLR, Oberpfaffenhofen, West Ger. Report DLR-Mitt-75-23, 14 Nov. 1975 Original German report available from DFVLR, Cologne DM 26
(ESA-TT-293; DLR-Mitt-75-23) Avail: NTIS HC A04/MF A01

The acceptance tests are used to illustrate the complex relationship between the mechanics, control, and steering equipment (drives), and the radiation characteristics of the antenna. Coincidence of the mechanical and electrical axes at an elevation angle of 45 deg is achieved by adjusting the individual elements. The surface roughness of the main dish sets an upper limit to the frequency range. The maximum velocity and acceleration of the pedestal largely determines the field of application for space probes as well as earth satellites. The pointing accuracy and gain of the antenna have to be made compatible. Points which must be considered when preparing the specifications and acceptance tests of large steerable dish antennas are outlined, thus forming a work of reference for project engineers faced with such complex problems. Author (ESA)

N77-10447# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
MANUFACTURING METHODS AND TECHNOLOGY PROGRAM FOR BEAM LEAD SEALED JUNCTION SEMICONDUCTOR DEVICES Quarterly Progress Report, 21 Aug. - 21 Nov. 1975
Art Peltier, Mike Crabtree, Don Zobel, and Joe Wise 21 Nov. 1975 83 p refs
(Contract DAAB07-75-C-0033; DA Proj. 2759753)
(AD-A023846; QPR-2) Avail: NTIS HC A05/MF A01 CSCL 09/5

The object of the study is to refine the processes required to fabricate beam-lead sealed junction devices in production quantities by manufacturing methods. A detailed evaluation is included on most devices not discussed in the First Quarterly Report. The status of all devices presently in design or processing is reviewed. GRA

N77-10448# Naval Surface Weapons Center, White Oak, Md.
ANALYSIS OF TWO LOW Q ACTIVE FILTER CIRCUITS Final Analysis Report
Dennis Stutzel and Stephen Martin 19 Dec. 1975 95 p refs
(AD-A023899; NSWC/WOL/TR-75-51) Avail: NTIS HC A05/MF A01 CSCL 09/5

Circuit equations for a sensitivity analysis of two active filter circuits are derived using a single pole model of the op amp. A BASIC computer program is used to calculate the sensitivities of center frequency, Q, and gain to variations in each component value and op amp parameter. The computer program also multiplies the sensitivities by the temperature coefficients of the circuit components and op amp parameters to indicate the relative amounts of temperature drift in filter characteristics that are caused by each component. A second method for determining drifts in filter parameters with temperature is also described; this approach makes use of a network analysis program to plot the temperature shifted transfer function of each filter based on component drifts in the worst case directions determined by the signs of the sensitivities. Both of these techniques are used to compare the temperature stabilities of four active filters related to the Gamma Detector of the Mk 48 Mod 1 Torpedo.
Author (GRA)

N77-10449# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ADVANCED ELECTRONIC TECHNOLOGY Quarterly Technical Summary Report, 1 Nov. 1975 - 31 Jan. 1976
Melvin A. Herlin and Alan L. McWhorter 15 Feb. 1976 20 p refs
(Contract F19628-76-C-0002; AF Proj. 649L)
(AD-A023869; ESD-TR-76-37) Avail: NTIS HC A02/MF A01 CSCL 09/3

This Quarterly Technical Summary covers the period 1 November 1975 through 31 January 1976. It consolidates the reports of Division 2 (Data Systems) and Division 8 (Solid State) on the Advanced Electronic Technology Program.
Author (GRA)

N77-10450# Florida Univ., Gainesville. Electron Device Research Center.
COMPUTER AIDED ENGINEERING OF SEMICONDUCTOR INTEGRATED CIRCUITS Interim Report, 1 Jul. - 31 Dec. 1975
David P. Kennedy Apr. 1976 254 p refs
(Contract DAAB07-75-C-1344; ARPA Order 2985)
(AD-A024459; EDRC-76-1; ECOM-75-1344-1) Avail: NTIS HC A12/MF A01 CSCL 09/4

The objectives of this program are to remove the empiricism associated with the design and manufacturing of custom integrated circuits and to reduce the cost of these circuits by devising improved computer-aided engineering techniques. During this period emphasis has been placed on integrated circuit device and process modeling. For device modeling the results presented include the: (1) development of a two-dimensional model for MOS and bipolar transistors; (2) development of a one-dimensional mathematical model for MOSFET operation; (3) studies on equivalent circuit modeling of transistor operation; (4) theoretical investigations of carrier mobility in the inversion layer of an MOSFET; (5) mathematical investigations for high-speed analysis of devices; (6) sheet resistivity test pattern model development, using Monte-Carlo techniques; and (7) hot carrier studies for inhomogeneous semiconductor material. For process modeling the results presented include (1) ion implantation; (2) thermal oxidation and chemical vapor deposition; (3) silicon epitaxy; and (4) thermal diffusion. Author (GRA)

N77-10451# Army Electronics Command, Fort Monmouth, N.J.
AIRCRAFT INSTALLATION AND TEST TECHNICAL AREA, AVIONICS LABORATORY CAPABILITIES
Michael Bereschinsky and Edmund Tognola Apr. 1976 17 p
(DA Proj. 1F2-64201-DC-97)
(AD-A024035; ECOM-4405) Avail: NTIS HC A02/MF A01 CSCL 09/3

This report describes the capabilities that are being provided by the Aircraft Installation and Test Technical Area, Avionics Laboratory located at Fort Monmouth, N.J. This technical area is composed of the following four teams: the Installation Engineering Team, the Data Acquisition and Test Team, the Mission Aircraft Systems Team, and the EMI/EMC Group. The equipment and facilities available and the services performed by each team of, this technical area are detailed in this report.
Author (GRA)

N77-10452# Dikewood Corp., Albuquerque, N.Mex.
ELECTROMAGNETIC PULSE ANALYSIS OF SMALL POWER SYSTEMS Final Report
David D. Babb and Joe P. Martinez Mar. 1976 190 p refs
(Contract F29601-74-C-0010)
(AD-A023927; AFWL-TR-75-181) Avail: NTIS HC A09/MF A01 CSCL 09/3

A rural electrical cooperative system is analyzed for EMP vulnerability. The coupling to a particular substation within the system is determined by considering the power distribution lines as antennas which pick up the incident EMP and treat the substation as a load. The most vulnerable components within the substation are determined and the energy levels necessary for failure are calculated. From the coupling problem the energy levels at various locations within the substation are known and the coupling to the vulnerable ports are determined. A ratio of coupled to threshold values is calculated; and if the ratio is above 1, failure is assumed, and if below 1, no failure is assumed. If failure is indicated the reasons are determined so as to recommend 'hardening' techniques. Although the detailed analysis is performed on one particular substation, the results may be compared to other similar systems throughout the country and perhaps knowledge of their response to an EMP may be gained from this analysis. Author (GRA)

N77-10453# Varian Associates, Beverly, Mass.
CFA DESIGN IMPROVEMENT PROGRAM Semiannual Report, 1 Jul. - 31 Dec. 1975
Mar. 1976 129 p refs
(Contract N00123-75-C-1294)
(AD-A024065) Avail: NTIS HC A07/MF A01 CSCL 09/5

This report describes the technical objectives and summarizes the accomplishments during the first six months (July 1, 1975 - December 31, 1975) of a program aimed at improving the design techniques for emitting sole, reentrant stream, crossed-field amplifiers. GRA

N77-10454# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
THIN FILM TRANSISTOR-ADDRESSED DISPLAY DEVICE Quarterly Report, 23 Feb. - 30 Sep. 1974
Thomas P. Brody, Fang C. Luo, David H. Davies, Zoltan P. Szepesi, Edward W. Greeneich, and W. Hester Mar. 1976 39 p ref
(Contract DAAB07-72-C-0061; DA Proj. 1S7-62705-AH-94)
(AD-A024081; Rept-75-9G9-DSPLA-R4; ECOM-72-0061-9; QR-9) Avail: NTIS HC A03/MF A01 CSCL 09/5

Having achieved an operational 6x6 inch 20 1pi TFT-EL display the program has now been oriented to examine a major improvement in resolution (to 30 1pi) and in overall performance. This report describes initial design and fabrication of the 6x6 inch 30 1pi TFT-EL display. This will contain approximately 30,000 individually addressable elements with a 33 mils center-to-center spacing. In addition the design includes some significant design changes to increase the elemental 'lit' area. Further detailed characterization on the 6 x 6 inch 20 1pi display

panel is also reported. Improved brightness and legibility in high brightness ambient has been achieved. Further power measurements confirm the initial data which indicated a low power dissipation level in the TFT-EL panel compared to other flat panel display technologies. The achievement of virtual operational perfection in the 6x6 inch 20 1pi (12,000 element) display is reported. GRA

N77-10455# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
THIN FILM TRANSISTOR ADDRESSED DISPLAY DEVICE Quarterly Report, Nov. 1973 - Feb. 1974
Thomas P. Brody, Fang C. Luo, David H. Davies, Z. P. Szepesi, and Edward W. Greeneich Mar. 1976 46 p
(Contract DAAB07-72-C-0061; DA Proj. 1S7-62705-AH-94) (AD-A023814; Rept-75-9G9-DSPLA-R3; ECOM-72-0061-8; QR-8) Avail: NTIS HC A03/MF A01 CSCL 09/5

The initial objective of this program, an operational 6 x 6 inch 20 lines per inch display, was fully achieved and delivered to the US Army Electronics Command. The device shows a high level of operational perfection with minimal defect counts. Initial characterization of the display indicates an acceptable brightness level and excellent power dissipation results. It is concluded that the viability of thin film transistor matrix addressing, as a technique for achieving realistic solid-state multi-element display devices, is proven. Further progress towards improved resolution and performance is anticipated. Author (GRA)

N77-10456# I-T-E Imperial Corp. Research, Colmar, Pa.
DEVELOPMENT OF FAULT CURRENT LIMITERS FOR ELECTRIC POWER SYSTEMS Final Report
Thomas H. Dodds, Narayan S. Rau, Edward D. Tyrlik, and Steven Welk Mar. 1976 519 p Sponsored by Electric Power Res. Inst.
(PB-252211/8; EPRI-TD-130) Avail: NTIS HC A22/MF A01 CSCL 09C

Current commutation to a parallel resistor is shown to be a feasible fault current limiter concept in general. Specifically, a conceptual limiter using a sand fuse as the arc voltage source or commutation device and a linear ohmic resistor as the parallel resistance is developed for at least to a 72.5kV system voltage. A simple current rate of rise sensing criteria with appropriate time delay to filter out noise etc. is employed as the fault sensor. Finally, a bypass switch is developed to carry the continuous load current, and fuse selector and fuse insertion switches introduce a new current commutating fuse after each operation of the fault current limiter. An LC resonant fault current limiter is shown to be economically attractive at system voltages of 242kV and above. Voltage sensing is determined to be the best means of fault detection for the resonant limiter. Various capacitor and inductor designs are analyzed and presented, and other fault current limiter concepts including a cryogenic/superconducting type are also discussed. GRA

N77-10457# ITT Electron Tube Div., Easton, Pa.
LONG LIFE X-RAY TUBES FOR PORTABLE SOURCES Triannual Report, 1 Oct. 1975 - 31 Jan. 1976
Charles L. Shackelford Apr. 1976 16 p
(Contract DAAB07-75-C-1334; DA Proj. 1S7-62705-AH-94) (AD-A023912; ECOM-75-1334-2; TR-2) Avail: NTIS HC A02/MF A01 CSCL 09/1

Work performed on the Long Life X-Ray Tube during the period 1 October 1975 to 31 January 1976 is described in this second triannual report. The object of the development is a tube for the portable X-ray system AN/TAQ-2 with substantially increased life over that presently available. Construction details and test data are presented for tubes tested during the period 1 June 1975 to 31 January 1976. Life tests show that anode erosion is the principal contributor to tube failure. Two proposed solutions are presented. One of these, a tungsten-rhenium alloy anode, has had one life test and shows capability of twice the life of presently available tubes. Tubes with heat treated tungsten anodes have been constructed and are awaiting test. GRA

N77-10458# Naval Research Lab., Washington, D.C.
ELECTROACOUSTIC MODELING OF MAGNETOSTRICTIVE SHELLS AND RINGS. PART 2: EIGSHIP PREDICTED PERFORMANCE; EXPERIMENTAL MEASUREMENTS; AND COMPUTER LISTING OF EIGSHIP Interim Report
S. Hanish, B. J. King, R. V. Baier, and P. H. Rogers 19 Apr. 1976 187 p refs
(NRL Proj. S01-29; RR1310341)
(AD-A024448; NRL-7964-Pt-2) Avail: NTIS HC A09/MF A01 CSCL 09/1

The mathematical model of the electroacoustic performance of a force-driven free-flooding magnetostrictive cylinder shell used as an underwater sound transducer, originally developed in another report, has been coded into a computer program called EIGSHIP. This program is designed to predict electrical and mechanical impedances of the loaded shell, transmitting responses, electroacoustic efficiency, surface velocities, far-field beam patterns, and other relevant performance parameters. An experimental check on the prediction capabilities of EIGSHIP was undertaken on three specially constructed magnetostrictive shells which were tested under water load conditions in an indoor test facility. A full discussion of the comparison of predicted and measured performance is presented. The coded listing of EIGSHIP and instructions on its input requirements and output format are furnished in detail. Samples of typical computer runs are displayed and commented on. GRA

N77-10459# Bendix Corp., Baltimore, Md. Communications Div.
TACTICAL MINIATURE CRYSTAL OSCILLATOR Semiannual Report, 15 Apr. - 15 Oct. 1975
H. M. Greenhouse, R. L. McGill, and W. Fefel Apr. 1976 40 p refs
(Contract DAAB07-75-C-1327)
(AD-A024195; ECOM-75-1327-1; Rept-471-2583-1010) Avail: NTIS HC A03/MF A01 CSCL 09/1

This report describes the further development of a fast warmup Tactical Miniature Crystal Oscillator (TMXO). The intended use for this TMXO is as a reference frequency source in advanced tactical communications systems and in time ordered navigational systems. The present effort is a continuation by the authors of a previous study which defined particular problem areas. The TMXO is an evacuated enclosure containing a thermal insulating pedestal, a vacuum sealed hybrid microcircuit and a thermally isotropic back filled crystal unit. Both packages are supported by the pedestal. Changes in the electrical, mechanical and thermal design are described, pertaining to the solution of the remaining problems. GRA

N77-10460# Naval Weapons Center, China Lake, Calif.
NUMERICAL METHOD FOR DETERMINATION OF MICROSTRIP INTERDIGITATED COUPLER DESIGN PARAMETERS
Donald D. Paolino Mar. 1976 37 p refs
(AD-A024028; NWC-TP-5843) Avail: NTIS HC A03/MF A01 CSCL 09/1

A method of determining design parameters for the microstrip interdigitated (Lange) coupler is presented. Parameters investigated include coupling coefficients, odd and even mode velocities, and characteristic impedance. A general method of analysis is reviewed, convergence of the method is studied, and a computer program implementing this analysis along with supporting test data are presented. Test results indicate a good agreement between measured and predicted coupling and directivity for the interdigitated couplers. GRA

N77-10461# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
COVARIANCE-INVARIANT DIGITAL FILTERING
Joseph Perl Mar. 1976 41 p refs
(Contract N00014-75-C-0518)
(AD-A024272; TR-17) Avail: NTIS HC A03/MF A01 CSCL 09/5

When discretizing continuous-time filters, one is often interested in preserving a property termed covariance-invariance. In this paper techniques are outlined for synthesizing discrete-time filters which are covariance-invariant with corresponding continuous-time filters. The synthesis techniques involve straight-forward matrix decompositions and polynomial root-finding algorithms that can easily be programmed on a digital computer. Applications of the technique to digital filter synthesis are outlined, with example designs presented for covariance-invariant Butterworth

and Chebyshev digital filters. Based on the frequency response of these designs it is argued that the method of covariance-invariance is superior to the methods of impulse-invariance and bilinear-z as a response matching design technique for the synthesis of digital filters. This superiority is especially apparent at sampling rates that are marginal with respect to filter critical frequencies. Moreover, the covariance-invariant designs are stably-invertible solutions to a so-called spectral factorization problem. This property may be important in inverse filtering applications. GRA

N77-10462# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SHUNT REGULATOR DESIGN FOR LES-8/9
Alan R. Millner 5 Mar. 1976 26 p refs
(Contract F19628-76-C-0002; AF Proj. 2029)
(AD-A023819; TN-1975-15; ESD-TR-76-62) Avail: NTIS HC A03/MF A01 CSCL 22/2

A shunt regulator design was developed for the LES-8 and -9 satellites. Design alternatives are compared, and a 100 kHz switching regulator was developed to system specifications. Test data are presented for the final regulator system. Transient and small signal regulator response are derived from an analysis of each mode of regulator behavior. Author (GRA)

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N77-10463* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HEAT EXCHANGER Patent
Roy F. Holmes (Gen. Dyn./Convair, San Diego, Calif.) and Edward E. Keller, inventors (to NASA) (Gen. Dyn./Convair, San Diego, Calif.) Issued 5 Oct. 1976 5 p Filed 5 Nov. 1974 Supersedes N75-10366 (13 - 01, p 0049) Sponsored by NASA
(NASA-Case-MFS-22991-1; US-Patent-3,983,933; US-Patent-Appl-SN-521006; US-Patent-Class-165-164; US-Patent-Class-165-170) Avail: US Patent Office CSCL 20D

An improved lightweight heat exchanger particularly suited for use in systems having low volume flow, high longitudinal gradient and high effectiveness requirements is described. The heat exchanger is characterized by a shell of an annular configuration, an endless plate of minimal thickness and of a substantially uniformly convoluted configuration disposed within the annular shell for defining a plurality of endless, juxtaposed passages, each having a low Reynold's number and being of an annular configuration. A pair of manifolds disposed 180 deg apart is mounted on the shell in communication with the passages through which counterflowing fluids are simultaneously introduced and extracted from the passageways for achieving a continuous transfer of heat through the convoluted plate.
Official Gazette of the U.S. Patent Office

N77-10464# Kyoto Univ. (Japan). Dept. of Aeronautics.
TRANSONIC NOZZLE FLOWS OF GASES WITH A RATE PROCESS
Ryuji Ishii 9 Apr. 1976 33 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal in Feb. 1977
Avail: NTIS HC A03/MF A01

The transonic flow of a vibrationally relaxing or a chemically reacting gas in a convergent-divergent nozzle is considered. The procedures used to solve the flow equations is similar to that first used by Hall, and the solution is based on a series expansion in terms of the wall geometery in the transonic region. The nonuniformities of flow properties across the flowfield is taken into consideration. Taulbee and Boraas have already solved such a problem for a frozen flow by a sort of inverse method, in which the governing equations are written with the stream function as an independent variable. In this paper the problem is solved by a direct method and analytical solutions are obtained for both frozen and equilibrium flows. Author

N77-10465*# Washington State Univ., Pullman. Computer Science Dept.
AN INVESTIGATION OF CONDENSATION HEAT TRANSFER IN A LOSED TUBE CONTAINING A SOLUBLE NONCONDENSABLE GAS Final Report
Elric W. Saaski and Richard J. Hanson [1976] 82 p refs
(Grant NsG-2015)
(NASA-CR-149095) Avail: NTIS HC A05/MF A01 CSCL 20D

A more exact one-dimensional condensation heat transfer model for insoluble gases was developed and compared with experimental data. Modifications to this model to accommodate soluble gas behavior were also accomplished, and the effects on gas front behavior demonstrated. Analytical models for condensation heat transfer are documented, and an optical method used for measuring gas concentration profiles is outlined. Experimental data is then presented and interpreted. Author

N77-10466*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
CONVECTION SENSITIVITY AND THERMAL ANALYSES FOR INDIUM AND INDIUM-LEAD MIXING EXPERIMENT (74-18)
S. V. Bourgeois and J. P. Doty May 1976 56 p refs
(Contract NAS8-31671)
(NASA-CR-150035; LMSC-HREC-TR-D496846) Avail: NTIS HC A04/MF A01 CSCL 20D

Sounding rocket Experiment 74-18 was designed to demonstrate the effects of the Black Brandt rocket acceleration levels (during the low-g coast phase of its flight) on the motion of a liquid metal system to assist in preflight design. Some post flight analyses were also conducted. Preflight studies consisted of heat transfer analysis and convection sensitivity and convection modeling analyses which aided in the: (1) final selection of fluid materials (indium-lead melts rather than paraffins); (2) design and timing of heater and quench system; and (3) preflight predictions of the degree of lead penetration into the pure indium segment of the fluid. Postflight studies involved: (1) updating the convection sensitivity calculations by utilizing actual flight gravity levels; and (2) modeling the mixing in the flight samples. Author

N77-10467# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
GAMMA-ORDERED RESULTS FOR A SIMPLE FLUID
G. Stell (State Univ. of New York at Stony Brook) and J. J. Weis 27 Oct. 1976 20 p refs
(LPTHE-76/8) Avail: NTIS HC A02/MF A01

The radial distribution function obtained from Monte Carlo computations for a simple fluid are compared with approximation obtained from self-consistent ordering. In the liquid state the lowest order result is qualitatively satisfactory but leaves room for some quantitative improvement. In that state, a second order result, QUAD, is highly accurate and virtually indistinguishable from the EXP approximation of Andersen and Chandler, while a simplified second order result, LIN+ SQ, is nearly the same. The latter has an advantage of greater analytic simplicity that may prove useful in certain applications. These results are also compared in the gaseous state, where none of the perturbation theoretic results are fully satisfactory. Author

N77-10468*# Hamilton Standard, Windsor Locks, Conn.
LIGHTWEIGHT LONG LIFE HEAT EXCHANGER Final Report
Earl K. Moore Jul. 1976 160 p
(Contract NAS9-14494)
(NASA-CR-151030; SVHSER-7077) Avail: NTIS HC A08/MF A01 CSCL 20D

A shuttle orbiter flight configuration aluminum heat exchanger was designed, fabricated, and tested. The heat exchanger utilized aluminum clad titanium composite parting sheets for protection against parting sheet pin hole corrosion. The heat exchanger, which is fully interchangeable with the shuttle condensing heat exchanger, includes slurpers (a means for removing condensed water from the downstream face of the

heat exchanger), and both the core air passes and slurpers were hydrophilic coated to enhance wettability. The test program included performance tests which demonstrated the adequacy of the design and confirmed the predicted weight savings. Author

N77-10469*# Kanner (Leo) Associates, Redwood City, Calif.
EXPERIMENTAL AND THEORETICAL STUDY OF TWO-DIMENSIONAL, TURBULENT, INCOMPRESSIBLE REATTACHMENT
J.-C. LeBalleur and J. Miranda Washington NASA Oct. 1976 36 p refs Transl. into ENGLISH of conf. paper ONERA-TP-1975-16 Presented at AGARD Meeting on Separated Flow, Goettingen, West Germany, 27-30 May 1975, p 17-1 to 17-13
(Contract NASw-2790)
(NASA-TT-F-17331) Avail: NTIS HC A03/MF A01 CSCL 20D

Turbulent reattaching flow downstream from a backward-facing step was tested using a two dimensional plane, incompressible configuration, with the ability to induce favorable or adverse pressure gradients in the potential flow. Detailed pressure and velocity measurements in this region make it possible to suggest general empirical laws whose efficiency relies on a thin initial separating boundary layer. Complete calculations were performed by obtaining a self-induced interaction by matching a wall dissipative layer with an inviscid and irrotational external flow. Except in the case of weak viscous interaction regions, an inverse calculation process is used to avoid singularities, according to Klineberg's method for transonic airfoils. The wall pressure distribution is obtained from an integral boundary layer calculation. Author

N77-10470*# Transemantics, Inc., Washington, D.C.
METHOD OF LOCAL SIMILARITY OF CALCULATION OF CHARACTERISTICS OF A LAMINAR BOUNDARY LAYER OF FLUID
A. N. Popkov NASA Nov. 1976 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (USSR), no. 2, Feb. 1976 p 83-88
(Contract NASw-2792)
(NASA-TT-F-17282) Avail: NTIS HC A02/MF A01 CSCL 20D

Approximate methods of calculating laminar boundary layers have certain advantages over precise numerical methods; the most important of these is their simplicity of application. The condition of minimum error in calculation is imposed. Author

N77-10471# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Aeronautical Engineering.
NUMERICAL SOLUTION OF THE SELF-SIMILAR REFLECTION OF A STRONG SHOCK WAVE
Lasse K. Karlsen 14 Sep. 1976 23 p refs
(KTH-Aero-FI-46; TRITA-FPT-018) Avail: NTIS HC A02/MF A01

The reflection of a strong shock wave from a wedge in a shock tube is considered. This problem is solved by a finite-volume technique using the MacCormack difference scheme. This numerical method is fully conservative, and the self-similar steady state is obtained by expanding the computational volumes along with the propagation of the incident shock. The errors to be expected in the steady state result are discussed. These errors are mainly due to the inconsistency of the scheme across flow field discontinuities, and some typical situations for an oblique shock are treated. It is shown how the numerical method should be applied to minimize the steady state errors. Author

N77-10472# New York Univ., N.Y. Dept. of Environmental Medicine.
GREEN'S FUNCTION TECHNIQUES FOR THE SOLUTION OF TIME-DEPENDENT POTENTIAL FLOWS WITH A FREE SURFACE IN A BOUNDED DOMAIN
A. Harten and Y. K. Chung Dec. 1975 39 p refs
(Contract E(11-1)-3077)
(COO-3077-100) Avail: NTIS HC A03/MF A01

Numerical techniques are described for the computation of the boundary value of time dependent potential flows on a bounded domain where part of the boundary is a free surface. The linearized free surface condition relates the normal derivative of the potential to time derivatives of the potential on the undisturbed free surface. It is assumed that on the fixed part of the boundary the normal derivative of the potential is a given function of time. The problem is formulated via Green's identity. The first technique, QUAKE, uses the classical time dependent Green's function which satisfies the linearized free surface condition, and the boundary value of the potential is obtained as a solution of an integral equation. The second technique, TDIET, uses the time independent fundamental solution of the Laplace equation and the boundary value of the potential is obtained as a solution to a differentio-integral equation. ERA

N77-10473# Energy Research and Development Administration, Morgantown, W. Va.
GENERAL PURPOSE DIFFUSIVITY MODEL FOR FLUID FLOW AND HEAT CONDUCTION IN POROUS MEDIA
W. K. Sawyer and C. D. Locke Apr. 1976 140 p refs
(MERC/SP-76/1) Avail: NTIS HC A07/MF A01

A general purpose three dimensional finite difference diffusivity model is developed with the capability of simulating horizontal or vertical induced fractures by several different methods. Fractures may be of finite, semi-infinite, or infinite flow capacity. In the first case, the fracture width and permeability is specified and the appropriate permeability of each node penetrated by a fracture is altered according to the relationship for linear beds in parallel. In addition, the block size normal to the fracture orientation is decreased to a very small value thus giving a reasonable representation of the fissure. A semi-infinite fracture is simulated for a specified total rate by uniformly distributing the flow along the reservoir nodes penetrated by the fracture. Finally, an infinite capacity fracture may be simulated for either the constant potential or constant rate case. Author (ERA)

N77-10474# Sandia Labs., Albuquerque, N.Mex.
IMPROVED REAL GAS ROUTINES FOR SANDIA'S NASA AMES FLOW FIELD PROGRAM
R. R. Eaton and D. E. Larson Feb. 1976 44 p ref
(Contract AT(29-1)-789)
(SAND-75-0493) Avail: NTIS HC A03/MF A01

The required computer run time for a difficult high Mach number case was reduced from 1330 seconds to 151 seconds in real gas subroutines. Author (ERA)

N77-10475# Ecole Nationale Superieure de Techniques Avancees, Paris (France).
COLLAPSE OF A CAVITATION BUBBLE NEAR A FREE SURFACE
G. Chahine Dec. 1975 14 p refs In FRENCH; ENGLISH summary Presented at the Symp. Ecoulements Diphasique et Cavitation dans les Systemes de Prod. d'Energie, Grenoble, France, 1976
(Contract DRME-73/645)
(Rept-059) Avail: NTIS HC A02/MF A01

Interaction between a collapsing bubble and a free surface was investigated theoretically and experimentally using high speed photography. A limit value for the distance from the free surface to the center of the bubble and back along its radius was found. Under this limit, the free surface is not disturbed during the collapse in the first approximation. Only in this case can the method of images be used and the free surface replaced by an image source, the free surface symmetrical with respect to the sink representing the bubble. Above this limit, observations show a singular perturbation in the free surface with the formation of a thin spike directed to the air. In all cases, the bubble is repelled from the free surface, and the re-entering jet, formed during collapse, is oriented away from it. Author (ESA)

N77-10476# Societe Nationale Industrielle Aerospatiale, Suresnes (France).
EXTENSION OF THE FINITE ELEMENT METHOD TO A TWO DIMENSIONAL TRANSONIC FLOW [EXTENSION DE LA METHODE DES ELEMENTS FINIS AU BIDIMENSIONNEL TRANSSONIQUE]
Y. Morchoise Paris Assoc. Aeron. et Astronautique de France Nov. 1975 12 p In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-5; ISBN-2-7170-0383-5) Avail: NTIS HC

A02/MF A01; CEDOCAR, Paris FF 15 (France and EEC) FF 19 (others)

The finite element method was applied on a two-dimensional transonic flow. The problem was studied for a two-dimensional flow around a nonsymmetric body in infinite space. Numerical examples of a biconvex profile and of the NACA 0012 profile are given. It is concluded that the finite element method can with relative ease be adapted to supercritical flows. ESA

N77-10477# Societe Nationale Industrielle Aerospatiale, Paris (France).

CALCULATION OF THREE DIMENSIONAL SUPERSONIC FLOW WITH A FINITE DIFFERENCE METHOD [CALCUL D'ECOULEMENTS 3-D SUPERSONIQUES PAR UNE METHODE AUX DIFFERENCES FINIES]

G. Brange Assoc. Aeron. et Astronautique de France 1976 46 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975

(AAAF-NT-76-6; ISBN-2-7170-0384-3) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

The finite difference method was used to calculate three-dimensional supersonic shock waves. The method is based on the work of P. Kutler, and the discrete functions of Mac Cormack of the predictor-corrector type are applied on conservative flow equations. Results show the flexibility of this method. The gliding condition at the wall and inversion of Rankine-Hugoniot equations are dealt with in annexes. ESA

N77-10478# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).

TURBULENT BOUNDARY LAYER THICKENING AND SEPARATION RESULTING FROM THREE DIMENSIONAL INTERACTION WITH AN OBLIQUE SHOCK [EPAISSISSEMENT ET SEPARATION D'UNE COUCHE LIMITE TURBULENTE SOUMISE A UNE INTERACTION TRIDIMENSIONNELLE AVEC UN CHOC OBLIQUE]

J. Cousteix and R. Houdeville Paris Assoc. Aeron. et Astronautique de France 1976 27 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975

(AAAF-NT-76-15; ISBN-2-7170-0393-2) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

An experimental study of the three-dimensional interaction between a shock wave and a turbulent boundary layer is presented. The shock wave produced by a dihedron is perpendicular to the wall on which the boundary layer develops itself but oblique to the general direction of the flow. The Mach number was of the order of 2.3. The boundary layer study was carried out for different angles of the dihedron nearly up to the shock wave giving rise to separation. Boundary layer development calculations are presented. The results were compared with the experiments, using the static pressure distribution measured at the wall. ESA

N77-10479# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Stroemungsmechanik.

SIMILAR SOLUTIONS OF THE DIFFERENTIAL EQUATIONS FOR MEAN VELOCITIES, TURBULENCE ENERGY AND TURBULENCE LENGTH SCALE

Julius Christian Rotta and Heinrich Vollmers 31 Mar. 1976 80 p refs In GERMAN; ENGLISH summary Report will also be announced as translation

(DLR-FB-76-24) Avail: NTIS HC A05/MF A01; DFVLR, Cologne DM 37.40

The system of partial differential equations to describe the mean velocities, the kinetic energy of fluctuations, and the characteristic length scale of turbulent flow was reduced to a system of ordinary differential equations using similarity transformations. The equations were solved numerically for six cases (plane free jet, plane wake, free mixing layer, fully developed plane channel flow, axisymmetric free jet, and fully developed pipe flow). The influence of the empirical coefficients of the equations on the solutions was studied. A single set of coefficients, which results from the investigations, is taken as a basis to compare the calculated results with experimental data. The agreement between theory and experiment is, on the whole, satisfactory. Author (ESA)

N77-10480# European Space Agency, Paris (France).

EXPERIMENTAL INVESTIGATION OF THE BEHAVIOR OF ABLATING BODIES OF DIFFERENT SHAPE AND MATERIAL COMPOSITION

Knud Kindler Sep. 1976 57 p refs Transl. into ENGLISH of "Exptl. Untersuch. des Ablationsverhaltens von einfachen Koerpern unterschiedlicher Nasenform u. Materialzusammensetzung", DFVLR, Cologne Report DLR-FB-76-08, 15 Jan. 1976 Original German report available from DFVLR, Cologne DM 23.70

(ESA-TT-313; DLR-FB-76-08) Avail: NTIS HC A04/MF A01

An investigation of polytetrafluorethylene ablation models in an arc heated air flow is described. The experiments were carried out to show the influence on the ablation process of the energy content of the flow, the probe shape, and the addition of different anorganic materials. Blunted cones and cylinders with hemispherical and flat noses made of PTFE and PTFE with 25% additions of, respectively, glass, ceramic, and graphite were investigated. The internal temperatures and the recession during ablation are pointed out. Author (ESA)

N77-10481# European Space Agency, Paris (France).

FLOW AND HEAT TRANSFER MEASUREMENTS IN CORNER REGIONS AT HYPERSONIC SPEEDS

Hermann-Josef Schepers Jun. 1976 33 p refs Transl. into ENGLISH of 'Untersuch. der wandnahen Stroemung u. des Waermeuebergangs im Bereich laengsangestroemter Ecken bei Hyperschallanstroemung', DFVLR, Cologne Report DLR-FB-76-02, 1976 Original German report available from DFVLR, Cologne DM 15.60

(ESA-TT-302; DLR-FB-76-02) Avail: NTIS HC A03/MF A01

In the hypersonic blow down wind tunnel H-1 of DFVLR's Inst. for Applied Gas Dynamics, flow and heat transfer measurements were carried out at free stream Mach 8.9 for simple corner models, consisting of two flat plates intersecting at 90 deg with different wedges in the rear section. To estimate the effects of temperature, a method of contactless, non-steady temperature measurements was used. Results show the different influences of the complex flow field on the heat transfer distribution in the corner region at different angles of attack, wedge angles, and leading edge curvature. Author (ESA)

N77-10482# European Space Agency, Paris (France).

INFLUENCE OF NOSE RADIUS AND CONE LENGTH ON HEAT TRANSFER AT THE STAGNATION POINT IN LOW DENSITY FLOW

Farouk Bachour Jun. 1976 22 p refs Transl. into ENGLISH of 'Nasenradius u. Kegellaenge als Einflussfaktoren auf den Waermeuebergang im Staupunkt im Bereich verduennter Stroemungen', DFVLR, Cologne Report DLR-FB-76-04, 1976 Original German report available from DFVLR, Cologne DM 10.80

(ESA-TT-303; DLR-FB-76-04) Avail: NTIS HC A02/MF A01

Results of heat transfer measurements on blunt cones are presented. Three conical Teflon models with 5 deg half angle and different nose radii were used in conjunction with two conical bases. An infrared photography technique was used for temperature measurements. Experimental results show that the nose radius and the cone length influence significantly the heat transfer at the stagnation point. Author (ESA)

N77-10483# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.

ELECTROHYDRODYNAMIC EFFECTS ON MINIMUM FILM BOILING Research Report, 1 Apr. 1973 - 31 Dec. 1975

T. B. Jones Jan. 1976 80 p refs

(Grants NSF GK-37398; NSF ENG-74-24113)

(PB-252320/7; NSF/ENG-74-24113-RR1-76; RR-1) Avail: NTIS HC A05/MF A01 CSCL 20I

Strong nonuniform electric fields are known to alter and usually to enhance convective and ebullient heat transfer in liquids. Nucleate and film boiling in the presence of an electric field have been studied, however, of these two ebullient processes, nucleate boiling has received far more attention. Thus, electrohydrodynamically coupled film boiling is the subject of the present study. A theoretical model is developed which accounts

for the observed effect as a surface wave eletrohydrodynamic coupling mechanism at the vapor-liquid interface. Different models are presented for various electroquasistatic regimes including: perfectly conducting liquid; insulating liquid, dc applied electric field; and insulating liquid, ac applied electric field. GRA

N77-10484# Naval Ship Research and Development Center, Bethesda, Md.

DESCRIPTION AND EVALUATION OF DIGITAL-COMPUTER PROGRAM FOR CALCULATING THE VISCOUS DRAG OF BODIES OF REVOLUTION

Keith P. Kerney and Nadine M. White Dec. 1975 147 p refs (AD-A023995; DTNSRDC-4641) Avail: NTIS HC A07/MF A01 CSCL 20/4

A digital-computer program has been written for calculating the viscous drag of streamlined bodies of revolution in constant-density axial flow. The integral approach adopted incorporates recently improved methods for predicting the transition point and for calculating the turbulent boundary layer. The inputs to the computer program are the body geometry, the associated inviscid pressure distribution, and the body-length Reynolds number. Agreement of calculated and measured drag coefficients is good, particularly in cases where the transition point is predicted accurately. Author (GRA)

N77-10485*# Pennsylvania State Univ., University Park. Applied Research Lab.

CORRELATIONS BY THE ENTRAINMENT THEORY OF THERMODYNAMIC EFFECTS FOR DEVELOPED CAVITATION IN VENTURIS AND COMPARISONS WITH OGIVE DATA

M. L. Billet, J. W. Holl, and D. S. Weir 11 Dec. 1975 47 p refs

(Grant NGL-39-009-001; Contract N00017-73-C-1418)

(NASA-CR-148996; AD-A024414; TM-75-291) Avail: NTIS HC A03/MF A01 CSCL 20/4

A semi-empirical entrainment theory was employed to correlate the measured temperature depression, Delta T, in a developed cavity for a venturi. This theory correlates Delta t in terms of the dimensionless numbers of Nusselt, Reynolds, Froude, Weber and Peclet, and dimensionless cavity length, L/D. These correlations are then compared with similar correlations for zero and quarter caliber ogives. In addition, cavitation number data for both limited and developed cavitation in venturis are presented. Author (GRA)

N77-10486*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE SLOW RECIRCULATING FLOW NEAR THE REAR STAGNATION POINT OF A WAKE Interim Report

Saul Abarbanel Sep. 1975 16 p refs Prepared by Tel Aviv Univ. (Israel)

(Grants NGR-47-102-001; AF-AFOSR-2370-72; AF Proj. 9781)

(NASA-TM-X-74156; AD-A024369; AFOSR-76-0479TR; Rept-75-18) Avail: NTIS HC A02/MF A01 CSCL 20/4

A model is suggested in which some of the important features of the circulating flow inside the two-dimensional near wake are derived by assuming a slow viscous flow. The theory considers the flow away from the body base. It is found that there is a region of constant speed merging, as we go downstream, into a region of stagnation-apex flow. The velocity returning from the rear stagnation point along the center streamline is shown to be a slowly varying function of the 'wedge-angle,' of the wake and to be roughly one half the velocity at the edge of the shear layers driving the wake-cavity flow. These results seem to be in agreement with experimental data. Author (GRA)

N77-10487# University of Southern Calif., Los Angeles. Dept. of Mechanical Engineering.

UNSTEADY SHOCK WAVE INITIATION OF A DETONATION WAVE IN A COMPRESSIBLE GAS MIXTURE Final Report

Robert George Surette and Melvin Gerstein Dec. 1975 216 p refs

(Grant AF-AFOSR-1918-70; AF Proj. 9711)

(AD-A024358; AFOSR-76-0510TR) Avail: NTIS HC A10/MF A01 CSCL 20/4

The equations for calculating the time dependent growth of a H2-02-Ar detonation wave from a shock wave are presented and compared with experiment. The sensitivity of the transition to the precursor shock strengths is illustrated as is the dependent of the transition on reaction rate. Author (GRA)

N77-10488# Purdue Univ., Lafayette, Ind. Computational Fluid Mechanics Group.

ON THE NOMINALLY STEADY TWO-DIMENSIONAL TIME-MEAN TURBULENT BOUNDARY LAYER Interim Report, 1 May 1975 - 31 Jan. 1976

J. D. A. Walker, D. E. Abbott, and R. K. Scharnhorst Feb. 1976 93 p refs

(Grant AF-AFOSR-2707-74; AF Proj. 9781)

(AD-A023939; CFMTR-76-1; AFOSR-76-0489TR) Avail: NTIS HC A05/MF A01 CSCL 20/4

The flow in the wall layer of a turbulent boundary layer, which is two-dimensional and steady in the time-mean sense, is investgated. The theory is motivated by recent experimental evidence that reveals that the wall layer is a region which is laminar-like in character and which is dominated by the brusting phenomenon. A solution is obtained for the time dependent flow in the wall layer which is valid during the period between bursts; from this is a mean profile is defined. It is demonstrated that the wall region flow is not universal but exhibits a strong dependence on pressure gradient. The theory is compared directly with experimental data and the agreement is very satisfactory. Author (GRA)

N77-10489# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.

PULSE PROPAGATION IN FLUID-FILLED TUBES

J. S. Walker and J. W. Phillips Nov. 1975 30 p refs

(Grant NSF ENG-74-23778)

(PB-255880/7; T/AM-404; UILU-ENG-75-6007) Avail: NTIS HC A03/MF A01 CSCL 20D

A theory for the propagation of pressure pulses in an inviscid compressible fluid contained in a thin-walled elastic tube is presented. It represents an improvement over the classical waterhammer theory because the restriction that the speed of sound in the tube material must be much greater than that in the fluid has been removed and because the restriction that the pulse length must be much greater that the tube diameter has been somewhat relaxed. The theory is applied to a capped tube with an axial impulsive force applied to the capped end for a short period. Numerical solutions using the method of characteristics are presented for a water-filled copper tube and for two different pulse lengths. GRA

N77-10490# Los Alamos Scientific Lab., N.Mex.

APPLICATION OF A DRIFT-FLUX MODEL TO FLASHING IN STRAIGHT PIPES

C. W. Hirt Jul. 1976 20 p refs

(Contract W-7405-eng-36)

(PB-254968/1; LA-6005-MS; NR-DRSR-001) Avail: NTIS HC A02/MF A01 CSCL 20D

A computer program, SOLA-DF, was written to solve the unsteady, two-dimensional equations of motion for a two-phase mixture. The equations solved are based on the drift-flux approximation and include a phase transition model and a general drift velocity calculation. The SOLA-DF code is used for a study of the blowdown of straight pipes initially filled with water at high temperature and pressure. Computed results are presented that show the relative importance of phase transition rates, pipe friction, drift velocity magnitude, and other model variations. The computed results are also compared with experimental data. GRA

N77-10491# Westat Research, Inc., Bethesda, Md. Dept. of Mechanical Engineering and Mechanics.

PULSATILE FLOW THROUGH AN ORIFICE Progress Report, Apr. 1974 - Dec. 1975

R. A. Bajura, M. T. Pellegrin, and L. R. Farr Jan. 1976 85 p refs

(Grant NSF ENG-74-10399)

(PB-255179/4) Avail: NTIS HC A05/MF A01 CSCL 20D

A summary of experimental results obtained in a study of the performance of orifice meters under pulsating flow conditions. Three orifice meter beta ratios of 0.35, 0.50, and 0.70 were

studied for pressure tap configurations of flange taps, D and D/2 taps, and vena contracta taps. Velocity profiles and differential pressure measurements were obtained for flows with pulsation frequencies in the range of 2-8 Hz with flow Reynolds numbers in the range of 10-20,000 based on pipe diameter of 4 inches. GRA

N77-10312*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ORIFICE RESISTANCE FOR EJECTION INTO A GRAZING FLOW
Kenneth J. Baumeister *In its* Advan. in Eng. Sci., Vol. 3 1976 p 895-905 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 20D

N77-10316*# Tennessee Technological Univ., Cookeville.
ONE-DIMENSIONAL WAVE PROPAGATION IN PARTICULATE SUSPENSIONS
Steve G. Rochelle and John Peddieson, Jr. *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 947-954 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10317*# Iowa State Univ. of Science and Technology, Ames.
A CORRESPONDENCE PRINCIPLE FOR STEADY-STATE WAVE PROBLEMS
Lester W. Schmerr *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 955-962 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10328*# Joint Inst. for Advancement of Flight Sciences, Washington, D. C.
THE DIFFUSION APPROXIMATION. AN APPLICATION TO RADIATIVE TRANSFER IN CLOUDS
Robert F. Arduini and Bruce R. Barkstrom *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1085-1092 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10343*# General Electric Co., Philadelphia, Pa. Research and Development Center.
THE dc ARC CHARACTERISTICS IN SUBSONIC ORIFICE NOZZLE FLOW
Henry T. Nagamatsu and Richard E. Kinsinger *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1247-1264 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10346*# Naval Research Lab., Washington, D.C.
FLUX-CORRECTED TRANSPORT TECHNIQUES FOR TRANSIENT CALCULATIONS OF STRONGLY SHOCKED FLOWS
J. P. Boris *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1291-1300 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

N77-10359*# Cincinnati Univ., Ohio.
NUMERICAL AND APPROXIMATE SOLUTION OF THE HIGH REYNOLDS NUMBER SMALL SEPARATION PROBLEM
R. T. Davis *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1451-1465 refs (For primary document see N77-10345 01-31)
(Contracts N00014-76-C-0364; N00014-76-C-0359)
Avail: NTIS HC A22/MF A01

N77-10360*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE RELATIVE MERITS OF SEVERAL NUMERICAL TECHNIQUES FOR SOLVING THE COMPRESSIBLE NAVIER-STOKES EQUATIONS
Terry L. Holst *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1467-1481 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 20D

N77-10361*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CALCULATION OF A SEPARATED TURBULENT BOUNDARY LAYER
Barrett Baldwin and Ching Mao Hung *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1483-1492 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 20D

N77-10362*# Old Dominion Univ., Norfolk, Va.
THE LIFT FORCE ON A DROP IN UNBOUNDED PLANE POISEUILLE FLOW
Philip R. Wohl *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1493-1504 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

N77-10363*# Oregon State Univ., Corvallis.
STABILITY OF FLOW OF A THERMOVISCOELASTIC FLUID BETWEEN ROTATING COAXIAL CIRCULAR CYLINDERS
Nabil N. Ghandour and M. N. L. Narasimhan *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1505-1507 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

N77-10364*# Oakland Univ., Rochester, Mich.
STABILITY OF A VISCOUS FLUID IN A RECTANGULAR CAVITY IN THE PRESENCE OF A MAGNETIC FIELD
C. Y. Liang and Y. Y. Hung *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1509-1519 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

N77-10371*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
HYPERSONIC HEAT-TRANSFER AND TRANSITION CORRELATIONS FOR A ROUGHENED SHUTTLE ORBITER
John J. Bertin (Texas Univ., Austin), Dennis D. Stalmach (Texas Univ., Austin), Ed S. Idar (Texas Univ., Austin), Dennis B. Conley (Texas Univ., Austin), and Winston D. Goodrich *In its* Advan. In Eng. Sci., Vol. 4 1976 p 1615-1627 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 20D

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N77-10492* National Aeronautics and Space Administration. Pasadena Office, Calif.
ION AND ELECTRON DETECTOR FOR USE IN AN ICR SPECTROMETER Patent
Wesley T. Huntress, inventor (to NASA) (JPL) Issued 5 Oct. 1976 8 p Filed 27 Aug. 1974 Supersedes N74-32890 (12 - 22, p 2695) Published under the second Trial Voluntary Protest Program as B 500, 981, 27 Jan. 1976 Sponsored by NASA (NASA-Case-NPO-13479-1; US-Patent-3,984,681; US-Patent-Appl-SN-500981; US-Patent-Class-250-291; US-Patent-Class-250-290) Avail: US Patent Office CSCL 14B

A detector for detecting ions and/or electrons present in a resonance cell of an ICR spectrometer is disclosed. The detector which operates on the Q-meter principle is driven by an external rf oscillator capable of providing rf frequencies up to about 15MHz at an adjustable low rf signal level, e.g., below 20mV. The detector is connected across the resonance of the cell to detect ions by detecting their cyclotron frequency. Electrons are detectable by connecting the detector across the cell's trapping plates and thereby detect the electrons' trapping motion, the frequency of

which is in the megahertz range.
Official Gazette of the U.S. Patent Office

N77-10493* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FOCUSED LASER DOPPLER VELOCIMETER Patent
James W. Bilbro, Werner K. Dahm, Ronald B. Campbell, Jr. (Raytheon Co., Huntsville, Ala.), Robert M. Huffaker, Harold B. Jeffreys, Albert V. Jelalian (Raytheon Co., Huntsville, Ala.), Wayne H. Keene (Raytheon Co., Huntsville, Ala.), Michael C. Krause (LMSC Huntsville, Ala.), Thomas R. Lawrence (LMSC, Huntsville, Ala.), Charles M. Sonnenschein, inventors (to NASA) (Raytheon Co., Huntsville, Ala.) et al Issued 5 Oct. 1976 7 p Filed 3 Dec. 1975 Supersedes N76-13459 (14 - 04, p 0454)
(NASA-Case-MFS-23178-1; US-Patent-3,984,686; US-Patent-Appl-SN-637247; US-Patent-Class-250-339; US-Patent-Class-250-338; US-Patent-Class-250-347; US-Patent-Class-356-106R) Avail: US Patent Office CSCL 14B

A system for remotely measuring velocities present in discrete volumes of air is described. A CO2 laser beam is focused by a telescope at such a volume, a focal volume, and within the focusable range, near field, of the telescope. The back scatter, or reflected light, principally from the focal volume, passes back through the telescope and is frequency compared with the original frequency of the laser, and the difference frequency or frequencies represent particle velocities in that focal volume.
Official Gazette of the U.S. Patent Office

N77-10494*# Texas A&M Univ., College Station. Remote Sensing Center.
INVESTIGATION OF A REAL-TIME PROCESSING SYSTEM FOR THE NASA MULTIFREQUENCY MICROWAVE RADIOMETER Final Report
11 Jun. 1976 33 p refs
(Contract NAS9-14821)
(NASA-CR-151033; RSC-3313-1) Avail: NTIS HC A03/MF A01 CSCL 14B

A study was conducted to investigate the data reduction and processing requirements for the multifrequency microwave radiometer system (MFMR). The objectives were to develop and evaluate algorithms and processing techniques which might provide for dedicated real time or near real time data processing and to develop a configuration design and processor recommendation to accomplish the data reduction. An analysis of the required data reduction and calibration equations was included along with the identification of sources of error which may be present in the (MFMR) data. The definition and evaluation of the significance of effects introduced by aircraft perturbation was given. Author

N77-10495*# Kanner (Leo) Associates, Redwood City, Calif.
AIRCRAFT MICROWAVE RADIOMETRIC EQUIPMENT WITH INCREASED SENSITIVITY FOR REMOTE SOUNDING OF UNDERLYING LAYERS
V. R. Amirkhanyan, Ye. A. Bespalova, M. G. Bulatov, V. M. Veselov, N. N. Vorsin, Yu. A. Militskiy, V. G. Mirovskiy, Yu. A. Nemlikher, V. V. Nikitin, M. D. Rayev et al Washington NASA Oct. 1976 17 p refs Transl. into ENGLISH of "Kompleks Samoletnoy mikrovolnovoy radiometricheskoy apparatury povysh-ennoy chuvstvitelnosti dlya distantsionnogo zondirovaniya podsti layushchika poverkhnostey", Rept-Pr-244 USSR Acad. Sci., Inst. of Space Res., Moscow, 1975 p 1-16
(Contract NASw-2790)
(NASA-TT-F-17266) Avail: NTIS HC A02/MF A01 CSCL 14B

Theoretical and experimental studies in recent years have shown the promise of radiophysical methods in remote sounding of underlying surfaces of the earth. The use of passive radiometer receivers for remote sensing is discussed. Brief presentations and technical characteristics are set forth for some radiometer receivers that were installed in an aircraft laboratory. The noise sensitivity of the various radiometers was studied, and is reported. Block diagrams are given which illustrate the radiometer equipment. Author

N77-10496*# Beckman Instruments, Inc., Anaheim, Calif.
NONINTRUSIVE FLOWMETER Final Report
M. W. Greene Sep. 1976 149 p refs
(Contract NAS9-14521)
(NASA-CR-151028; FR-2689-101) Avail: NTIS HC A07/MF A01 CSCL 14B

The results of analytical and experimental work performed in the design, fabrication, and test of a prototype nonintrusive gaging system for use in monitoring the consumption of earth-storable fuels and oxidants in either a one-g or a zero-g environment are explained. The design specifications were those applicable to the reaction control system and to the orbital maneuvering system (OMS) fuel and oxidant on the space shuttle while in orbit. The major requirement was for the measurement of flow pulses with sufficient accuracy to provide a continuous knowledge of the fuel and oxidant remaining in the OMS system to within 1% or better. An ultrasonic frequency chirp technique was used having a high inherent rejection for signals traversing stray paths, and for random noise generated by the flowing liquid. A detailed analysis of the frequency chirp approach for two modes of operation (period and phase changes), including an error analysis are reported. Author

N77-10497*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEVICE FOR MEASURING THE CONTOUR OF A SURFACE Patent Application
Ernest E. Burcher and Stephen Katzberg, inventors (to NASA) Filed 8 Nov. 1976 10 p
(NASA-Case-LAR-11869-1; US-Patent-Appl-SN-740155) Avail: NTIS HC A02/MF A01 CSCL 14B

A device for measuring the contour of a surface is considered. Light from a source is imaged by a lens onto the surface which concentrates the energy from the source into a spot. A scanning means is used to scan the spot across the surface. As the surface is being scanned the surface moves relative to the point of perfect focus. When the surface moves away from perfect focus the spot increases in size, while the total energy in the spot remains virtually constant. The lens then reimages the light reflected by the surface onto two detectors through two different sized apertures. The light energy going to the two detectors is separated by a beam splitter. This second path of the light energy through the lens further defocuses the spot, but as a result of the different sizes of the apertures in each light detector path, the amount of defocus for each is different. The ratio of the outputs of the two detectors which is indicative of the contour of the surface is obtained by a divider. NASA

N77-10498*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ROTARY LEVELING BASE PLATFORM Patent Application
Robert W. Delaplaine and Daniel L. Mossolani, inventors (to NASA) Filed 3 Nov. 1976 8 p
(NASA-Case-ARC-10981-1; US-Patent-Appl-SN-738218) Avail: NTIS HC A02/MF A01 CSCL 14B

A leveling apparatus for the precise level adjustment of a scientific instrument is analyzed. A base member is provided having a hollow cylindrical shape. A table for supporting the instrument rests on the base and has a shaft portion extending below the table. The upper portion of the shaft fits tightly into the hollow portion of the base member whereas the lower portion of the shaft is machined to fit loosely. The lower portion of the shaft is provided with a groove cut around the circumference thereof. Adjusting screws are threaded through the hollow cylindrical portion and are adapted to enter the groove. By adjusting the screws, the lower portion of the shaft is moved in a vertical plane since the shaft which is loosely fitted into the cylinder. The upper portion of the shaft which is tightly fitted into the upper end of the cylinder causes the cylinder to deform slightly providing a fulcrum point which allows the table to be leveled in response to the adjustment of the adjusting screws.
NASA

N77-10499# Texas Instruments, Inc., Attleboro, Mass.
DEVELOPMENT OF HIGH EFFICIENCY COLLECTOR PLATES Final Report
T. Santala and R. Sabol Feb. 1976 103 p refs
(Contract E(11-1)-2600)
(COO-2600-76/3 Avail: NTIS HC A06/MF A01

Composite metal technology was used to manufacture

intermetallic compound (IC) absorption surfaces and to combine them integrally with composite metal tube-in-sheet collector plates. Five material systems in which Al was one component metal and Fe, Cr, or Ni and their alloy was the other pair, were evaluated. All intermetallic compounds had high solar absorptance. The AlNi was most promising over a broad range of compounding conditions. After eight months exposure in a flat plate collector enclosure the characteristic properties of AlNi surfaces remained virtually unchanged. Only LCS/Cu composite metal tube-in-sheet collector plates could be manufactured successfully. The technical difficulties associated with integrating the intermetallic compound and tube-in-sheet technologies make the manufacturing of composite metal collector plates at the time being economically unfeasible. ERA

N77-10500# California Univ., Livermore. Lawrence Livermore Lab.
HIGH FREQUENCY SYSTEM PROJECT IMPLEMENTATION PLAN
L. L. Moon 12 Mar. 1976 92 p
(Contract W-7405-eng-48)
(UCID-17082) Avail: NTIS HC A05/MF A01

The High Frequency System is a mobile, digital diagnostic recording system for use at the Nevada Test Site. Many different kinds of event data are digitized in real-time by this system, and these data all recorded and stored for later read out and transmission to NADCEN. The hardware and software requirements of the High Frequency System are examined, and the parameters of the system are proposed. ERA

N77-10501# California Univ., Livermore. Lawrence Livermore Lab.
INTEGRAL HOLOGRAM AS A SCIENTIFIC TOOL
D. L. Vickers 12 Feb. 1976 8 p
(Contract W-7405-eng-48)
(UCID-17035) Avail: NTIS HC A02/MF A01

The value of the integral hologram as a visual aid in scientific research and technical presentations is described, and the procedure for making and displaying integral holograms at LLL is outlined. ERA

N77-10502# Sandia Labs., Albuquerque, N.Mex.
DESIGN OF A LINEAR RAMP CURRENT SUPPLY FOR BALLOON BORNE INSTRUMENTS
R. D. Myers and D. K. Werling Mar. 1976 13 p
(Contract AT(29-1)-789)
(SAND-75-0659) Avail: NTIS HC A02/MF A01

A linear current ramp and signal averaging circuit was designed for a heterodyne laser spectrometer and a mass spectrometer flown on Stratcom VI, a high altitude scientific balloon. ERA

N77-10503# Sandia Labs., Albuquerque, N.Mex.
PRECISION SHOCK ACCELEROMETER CALIBRATOR
H. L. Webster 1976 16 p Presented at 22d Intern. Instrumentation of Instrument Soc. of Am., San Diego, Calif., 25 May, 1976 Sponsored by ERDA
(SAND-75-6178; Conf-760513-3) Avail: NTIS HC A02/MF A01

The development of an absolute shock accelerometer calibration system is described and its precision and accuracy investigated. The system is comprised of a recoilless air gun which applies a mechanical pulse to a standard accelerometer supported and guided in an air bearing assembly. Accelerometer velocity change and output are digitally recorded and a calibration factor is calculated using an electrically interfaced computer. ERA

N77-10504# Sandia Labs., Albuquerque, N.Mex.
CONSTRUCTION AND OPERATION OF THE SURFACE CONTAMINANT DETECTOR MOD 2
R. E. Cuthrell, V. D. Nogle, and D. W. Tipping Mar. 1976 43 p refs
(Contract AT(29-1)-789)
(SAND-76-0099) Avail: NTIS HC A03/MF A01

Detailed construction and operating instructions, a parts list, and cost estimates for a surface contaminant detector are presented. The instrument is sensitive to the condensible contaminant content of environments and has been used for monitoring industrial facilities where contaminant sensitive parts are processed. ERA

N77-10505# Oak Ridge Y-12 Plant, Tenn.
COATING THICKNESS MEASUREMENTS USING SEMICONDUCTOR PHOTON DETECTORS
S. G. Snow 15 Jan. 1976 30 p refs Presented at Meeting of the Am. Soc. for Nondestructive Testing, Los Angeles, 9 Mar. 1976
(Contract W-7405-eng-26)
(Y-DA-6629; Conf-760321-1) Avail: NTIS HC A03/MF A01

High resolution gamma and X-ray semiconductor detectors make possible several new techniques for coating thickness measurements. First, one-sided measurements utilizing X-ray fluorescence and Compton scattering are described. Details of source selection and collimator design are given. Advantages of these types of measurements are demonstrated by describing typical applications. Finally, a two-sided radiation attenuation technique is described. This technique, which involves measuring the intensity of radiation transmitted through the sample at several different energies, extends the range of coating thickness measurements and provides very accurate measurements. Data which demonstrate this capability are given. ERA

N77-10506# Engins Matra, Velizy (France). Space Div.
A LARGE INFRARED TELESCOPE FOR SPACELAB, PHASE A, VOLUME 2 Final Report
15 Jun. 1976 297 p Prepared jointly with Tech. Phys. Dienst TNO and Rech. et Etudes d'Opt. et de Sci. Connexes 3 Vol.
(Contract ESTEC-2507/75-PP)
(Rept-60/181-Vol-2; ESA-CR(P)-833-Vol-2) Avail: NTIS HC A13/MF A01

Several trade-off studies and comparative analyses were performed in order to determine a large infrared telescope baseline and, in particular, the aperture diameter for flight onboard Spacelab. A comparative cost analysis was carried out with primary mirror diameter and f-numbers as parameters, taking into account the multi-mission aspect of the program. Not only the telescope development and production costs but also the launch cost and associated expenses were considered to obtain figures for the cost of an overall program extending over several years and several flights. The overall cost analysis is supported by a subsystem level analysis where the contribution of the mirror blank, optical element figuring, structure, and other less important elements have been parameterized. Structural mechanical engineering, the chopping secondary mirror, and Spacelab accommodation are dealt with. ESA

N77-10507# Engins Matra, Velizy (France). Space Div.
A LARGE INFRARED TELESCOPE FOR SPACELAB, PHASE A. VOLUME 3: DEVELOPMENT PLAN Final Report
15 Jun. 1976 168 p Prepared jointly with Tech. Phys. Dienst TNO and Rech. et Etudes d'Opt. et de Sci. Connexes 3 Vol.
(Contract ESTEC-2507/75-PP)
(Rept-60/181-Vol-3; ESA-CR(P)-833-Vol-3) Avail: NTIS HC A08/MF A01

Several trade-off studies and comparative analyses were performed in order to determine a large infrared telescope baseline and, in particular, the aperture diameter for flight onboard Spacelab. A comparative cost analysis was carried out with primary mirror diameter and f-numbers as parameters, taking into account the multi-mission aspect of the program. Not only the telescope development and production costs but also the launch cost and associated expenses were considered to obtain figures for the cost of an overall program extending over several years and several flights. The overall cost analysis is supported by a subsystem level analysis where the contribution of the mirror blank, optical element figuring, structure, and other less important elements have been parameterized. An overall development and mission economic analysis is presented. ESA

N77-10508# Appleton Lab., Slough (England).
PHASE A STUDY OF SPACELAB-BORNE ATMOSPHERIC PASSIVE EXPERIMENTS. VOLUME 4: ESTIMATES OF COSTS AND DEVELOPMENT TIMESCALES FOR PASSIVE SOUNDER PACKAGES ON 1ST SPACELAB Final Report

[1976] 61 p refs 5 Vol.
(Contract ESA-SC/97-HQ)
(ESA-CR(P)-836-Vol-4) Avail: NTIS HC A04/MF A01

The development program and cost estimates for preparing passive sounder experiment packages for the first Spacelab mission are presented. ESA

N77-10509# Hawker Siddeley Dynamics Ltd., Hatfield (England). Space Div.
EXTENSION TO PASSIVE SOUNDER STUDY. COMMON ATTITUDE POINTING SYSTEM (CAPS)
J. B. Farrow, comp. 1976 91 p refs Prepared for Appleton Lab. 5 Vol.
(Contract ESA-SC/97-HQ)
(HSD-TP-7592; ESA-CR(P)-836-Vol-5) Avail: NTIS HC A05/MF A01

The Common Attitude Pointing System (CAPS), which could satisfy the scan/stabilization requirements of most passive atmospheric sounders on Spacelab, is described. The capabilities and characteristics of other pointing systems were considered and their use rejected. Various options were considered for the control system and size of CAPS. A design is presented for a floating (i.e. entirely gimballed) reference system, which would carry a package of instruments weighing about 200 kg. The instruments would be mounted in a canister, providing a controlled thermal environment. Estimates are given for development time and costs. ESA

N77-10510# National Bureau of Standards, Washington, D.C. Electronic Technology Div.
NBS INTERAGENCY TRANSDUCER PROJECT Progress Report, 1 Jul. - 31 Dec. 1975
Paul S. Lederer, John S. Hilten, Carol F. Vezzetti, and John F. Mayo-Wells 10 Apr. 1976 27 p refs Sponsored in part by Naval Air Systems Command, and Sandia Labs.
(PB-253934/4; NBSIR-76-1060; PR-4) Avail: NTIS HC A03/MF A01 CSCL 14B

Initial experimental efforts are described relating to the development and evaluation of means to reduce the effects produced by thermal radiant-energy transients and other thermal inputs on pressure-transducer response. A series of tests was carried out to investigate the effects of a variety of protective coatings on the amount and rate of energy transmission through the diaphragm as revealed by measurements of the diaphragm back-side temperature. For purposes of experimental simplicity, mounted thin metal disks are used to simulate transducer diaphragms, and the temperature histories of both bare and protected disks are measured with thermocouples following exposure of the disks to thermal radiant-energy transients (of approximately 20 mJ/sq cm at the disk) generated by No. 22 photographic flashbulbs. Protective means investigated include various materials, such as tapes greases, and room-temperature-vulcanizing rubbers (RTVs), applied directly onto the disks as coatings. Data are given for each protective material tested. GRA

N77-10511# IRT Corp., San Diego, Calif.
GRADED-Z FLASH-BREMSSTRAHLUNG DEPTH DOSE SPECTROMETER Final Report
Victor V. Verbinski 24 Oct. 1975 42 p refs
(Contract N60921-74-C-0358)
(AD-A023764; INTEL-RT-8119-001) Avail: NTIS HC A03/MF A01 CSCL 18/4

The work described in this report is part of a flash-bremsstrahlung diagnostics development program, which has as its goal the specification of such output parameters as flash X-ray dose, its time variation, and the spectrum of bremsstrahlung (or X-ray) photons produced by electron bombardment of a tantalum target. GRA

N77-10512# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. PRAM Program Office.
LCC ANALYSIS OF FLIGHT RECORDER FOR F-4 WILD WEASEL AIRCRAFT Final Report
Thomas D. Meitzler 7 Apr. 1976 7 p refs
(AD-A023830; ASD/RAXA-76-6) Avail: NTIS HC A02/MF A01 CSCL 14/3

This report briefly summarizes a basic life cycle cost effort on two flight recorders. It discusses the background, approach, results, and conclusions of the study. GRA

N77-10513# Princeton Univ., N.J. Dept. of Chemical Engineering.
PYROLYSIS-MOLECULAR WEIGHT CHROMATOGRAPHY-VAPOR-PHASE INFRARED SPECTROPHOTOMETRY: A NEW ON-LINE SYSTEM FOR ANALYSIS OF POLYMERS. 1: INSTRUMENTATION
Erdogan Kiran and John K. Gillham Apr. 1976 29 p refs Submitted for publication
(Contract N00014-76-C-0200; NR Proj. 356-504)
(AD-A023780; TR-4) Avail: NTIS HC A03/MF A01 CSCL 14/2

An instrumental system consisting of a combination in series of a programmable pyrolyzer, a thermal conductivity detector, a mass chromatograph, and a fast-scan vapor-phase infrared spectrophotometer is described. GRA

N77-10514# Army Engineer Topographic Labs., Fort Belvoir, Va.
THE USE AND CALIBRATION OF DISTANCE MEASURING EQUIPMENT FOR PRECISE MENSURATION OF DAMS
Kenneth D. Robertson Mar. 1976 51 p ref
(AD-A023759; ETL-0048) Avail: NTIS HC A04/MF A01 CSCL 14/2

This report is intended as a practical guide to land surveyors using distance measuring equipment (DME) and making precise measurements of movements in dams and other large structures. The report consists of two parts. First, DME calibration, error sources, atmospheric corrections and correct use. Second, special techniques of trilateration and data reduction for precise mensuration on dams. Author (GRA)

36 LASERS AND MASERS

Includes parametric amplifiers.

N77-10515*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
DIELECTRIC BREAKDOWN INDUCED BY PICOSECOND LASER PULSES Interim Report
W. Lee Smith, J. H. Bechtel, and N. Bloembergen Oct. 1976 180 p refs
(Grant NGL-22-007-117; Contract N00014-75-C-0648; F44620-75-C-0088; Grant DAHC-15-73-G-16; NR Proj. 372-012)
(NASA-CR-149142; TR-665) Avail: NTIS HC A09/MF A01 CSCL 20E

The damage thresholds of transparent optical materials were investigated. Single picosecond pulses at 1.06 microns, 0.53 microns and 0.35 microns were obtained from a mode locked Nd-YAG oscillator-amplifier-frequency multiplier system. The pulses were Gaussian in space and time and permitted the determination of breakdown thresholds with a reproducibility of 15%. It was shown that the breakdown thresholds are characteristic of the bulk material, which included nine alkali halides, five different laser host materials, KDP, quartz, sapphire and calcium fluoride. The extension of the damage data to the ultraviolet is significant, because some indication was obtained that two- and three-photon absorption processes begin to play a role in determining the threshold. Throughout the visible region of the spectrum the threshold is still an increasing function of frequency, indicating that avalanche ionization is the dominant factor in determining the breakdown threshold. This was confirmed by a detailed study of the damage morphology with a high resolution microscope just above the threshold. The influence of self focusing is discussed, and evidence for beam distortion below the power threshold for complete self focusing is presented, confirming the theory of Marburger. Author

N77-10516*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LASER EXTENSOMETER Patent Application
Phillip J. Stocker (Rocketdyne, Canoga Park, Calif.) and Harris L. Marcus, inventors (to NASA) (Rocketdyne, Canoga Park, Calif.)

Filed 15 Oct. 1976 10 p Sponsored by NASA
(NASA-Case-MFS-19259-1; US-Patent-Appl-SN-732630) Avail: NTIS HC A02/MF A01 CSCL 20E

A laser extensometer capable of measuring the cross section of an object, such as its diameter is discussed. This device can conduct this measurement without actually physically touching said sample, and while said sample is moving. The extensometer contains a source of coherent radiant energy directed through an optics system to a sample object. The portion of the beam not striking the sample is divided by a beam splitter into a reference signal and a measurement signal. Knife edges are spaced apart a distance larger than the dimensions of the sample and create beams carrying information of the beam intensity. Knife edges are disposed in the path of both the reference and measurement signal for trimming the signals to eliminate non-uniform fringes. Each signal passes into a separate photodetector, and are divided by a divider giving an output which is a function of the sample shadow. NASA

N77-10517*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TWO WAVELENGTH DOUBLE PULSE TUNABLE DYE LASER Patent Application
Edward V. Browell, inventor (to NASA) Filed 3 Nov. 1976 11 p
(NASA-Case-LAR-12012-1; US-Patent-Appl-SN-738219) Avail: NTIS HC A02/MF A01 CSCL 20E

A laser that produces two pulses which are less than 500 microseconds apart with each pulse tunable to a different wavelength is considered. This laser was designed to eliminate several basic problems which arise when using the differential absorption LIDAR (DIAL) technique in remote detection of trace gases in the atmosphere. NASA

N77-10518# California Univ., Livermore. Lawrence Livermore Lab.
LASER DRIVEN ISOTHERMAL IMPLOSIONS
G. Dahlbacka and J. Nuckolls 28 Oct. 1974 18 p refs Presented at the 16th Annual Meeting of the Plasma Physics Div. of the Am. Phys. Soc., Albuquerque, N. Mex., 28-31 Oct. 1974 Sponsored by ERDA
(UCRL-75885; Conf-741079-20) Avail: NTIS HC A02/MF A01

A review of laser compression experiments is given. Diagrams illustrating various compression data are described. ERA

N77-10519# California Univ., Livermore. Lawrence Livermore Lab.
CAPSULE IMPLOSION BY EXTREMELY INTENSE CONVERGENT LIGHT
R. E. Kidder 14 Jan. 1976 8 p refs Revised Sponsored by ERDA
(UCID-15432-Rev-1) Avail: NTIS HC A02/MF A01

A description of the capsule of DT gas and the implosion process is given. A typical capsule consists of a thin spherical shell of gold containing DT gas at a relatively high density and a thick outer layer of a suitable propellant. The brightness and power requirements that a laser must satisfy if it is to be capable of imploding a DT capsule are discussed. ERA

N77-10520# California Univ., Livermore. Lawrence Livermore Lab.
STATUS OF LARGE NEODYMIUM GLASS LASERS
J. A. Glaze, W. W. Simmons, and W. F. Hagen Mar. 1976 11 p refs Presented at SPIE/SPSE Technical Symp., Reston, Va., 22 Mar. 1976
(Contract W-7405-eng-48)
(UCRL-77944; Conf-760306-4) Avail: NTIS HC A02/MF A01

The elements of a Nd: glass laser chain as it is constructed for fusion experiments are described. A brief overview of the ARGUS and SHIVA systems employing Nd lasers is given. ERA

N77-10521# Physics Lab. RVO-TNO, The Hague (Netherlands).
EXPERIMENTS WITH SHORT LASER PULSES RELATED TO WAVELENGTH CONVERSION OF LASER RADIATION
R. W. Meijer Nov. 1975 22 p refs In DUTCH; ENGLISH summary
(Contract A71/KL/19)
(PHL-1975-43; TDCK-67113) Avail: NTIS HC A02/MF A01

Experiments undertaken in connection with the development of an eye-safe laser rangefinder (wavelength 1.5 to 2.0 micron) are described. Stimulated Raman scattering from a liquid in a glass-fiber was investigated using a NdYAG-laser and a dye laser as light sources. The latter laser was modified in order to generate very short light pulses (100 psec) by means of mode-locking. The results are compared with recent publications in this area. Author (ESA)

N77-10522# Science Applications, Inc., Huntsville, Ala.
LASER RADAR SIGNATURE MEASUREMENTS 10.6 MICROMETERS RECEIVER MODIFICATION AND INTERFACING Final Report
9 Mar. 1976 13 p
(Contract DAAH01-76-A-0021)
(AD-A023997; SAI-77-538-HU) Avail: NTIS HC A02/MF A01 CSCL 17/5

This task has two principal objectives, both of which involved modification and addition to the 10.6 micrometers receiver for the LSMFT program. One objective of this task was to modify the receiver to provide a logarithmic representation of the 10.6 micrometers detector output, while the second objective was to provide the electronics necessary to interface the 10.6 micrometers receiver with a Fourier Analyzer (HP 5451B). GRA

N77-10523# United Technologies Corp., Norwalk, Conn. Norden Div.
LASER CARTRIDGE CONCEPT DEVELOPMENT STUDY Final Report, 9 May 1974 - 15 Nov. 1975
R. Wisnieff and D. Longo Apr. 1976 45 p refs
(Contract DAAB07-74-C-0376; DA Proj. 1S7-62703-DH-93)
(AD-A024442; UTC-1249-R-0018; ECOM-74-0376-F) Avail: NTIS HC A03/MF A01 CSCL 20/5

A laser cartridge has been developed which incorporates a Nd:YAG laser rod, passive Q-switch and resonator mirror into an integral bonded assembly. The laser rod is 3 millimeters diameter and 15 or 16 millimeters long. Output energy is over 0.5 millijoule when pumped with 1 joule into a Xenon flash lamp. The key elements of the program were: development of a total process for manufacturing nickel-complex dyed polymethylmethacrylate (PMMA) with accurate control of optical density in a high purity damage resistant material; selection of an optical adhesive with necessary dimensional stability and strength while bonding materials with widely different temperature expansion coefficients; the development of alignment and assembly procedures for consistently obtaining good laser cartridges. The program has demonstrated the feasibility and applicability of the ECOM laser cartridge concept. GRA

N77-10524# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PULSED LASER RANGING TECHNIQUES AT 1.06 AND 10.6 MICROMETERS
Richard J. Becherer 19 Mar. 1976 49 p refs
(Contract F19628-76-C-0002; ARPA Order 2752)
(AD-A024557; TT-8; ESD-TR-76-69) Avail: NTIS HC A03/MF A01 CSCL 20/5

Heterodyne and direct detection pulsed laser range finders at both 1.06 and 10.6 micrometers are compared. The application involves a transmitter/receiver at ground level ranging on unresolved high velocity projectiles which appear a few degrees above the horizon at ranges up to 10 km. The analysis includes effects of backgrounds, atmospheric turbulence, atmospheric attenuation and target surface characteristics. Available and projected CO2 and Nd:YAG laser power levels are assessed to determine expected operating ranges for each system. Author (GRA)

N77-10525# Exxon Research and Engineering Co., Linden, N.J.
PHOTODISSOCIATION DYE LASER Semiannual Technical Report, 1 Oct. 1975 - 31 Mar. 1976
Abraham Kasdan Apr. 1976 51 p refs
(Contract N00014-73-C-0048; ARPA Order 1806)
(AD-A023959; EXXON/GRUS.3BEOB.76) Avail: NTIS HC A04/MF A01 CSCL 20/5

The photodissociation dye laser (PDL) program is an effort to develop a new class of tunable liquid lasers operating in the

visible region of the spectrum. In the PDL scheme, laser action is expected to occur between an excited electronic state and the ground electronic state of radicals produced by the photodissociation of specific classes of molecules in solution. This scheme is expected to result in several significant advantages over conventional dye lasers. GRA

N77-10526# Naval Surface Weapons Center, White Oak, Md.
THE TWO-MIRROR ALIGNMENT SYSTEM
Charles J. Albers, Jr. 1 Sep. 1975 58 p refs
(AD-A023993; NSWC/WOL/TR-75-136) Avail: NTIS HC A04/MF A01 CSCL 20/5

An alignment system consisting of two servoed mirrors is an essential part of many laser systems. The function of these two-mirror alignment systems is to maintain the laser beam fixed in position and direction at some reference plane. Here, an in depth analysis of the staircase configuration is reported. Even with the restriction to the staircase configuration, the analysis is quite general since the configuration is not restricted to the case for which the exit beam direction is parallel to the input beam direction. In addition, the effects of various placements of the sensors is considered. It is found that, in general, the error signals are not directly proportional to the laser beam position and direction variables at the output of the alignment system. This can have important consequences for system specification and design. The control system aspects covered are stability, error signal derotation, and decoupling. Examples are given. Author (GRA)

N77-10527# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. High Energy Laser Directorate.
BEAM DIAGNOSTICS FOR THE ARMY-GAS DYNAMIC LASER (A-GDL)
T. G. Miller, R. G. Polk, F. P. Gibson, J. J. Wachs, and A. H. Jenkins 1 Dec. 1975 49 p refs
(DA Proj. 1X3-63314-D-093)
(AD-A023756; RH-76-6) Avail: NTIS HC A03/MF A01 CSCL 20/5

This report presents results of a series of beam diagnostics measurements on the Army Gas Dynamic Laser. Included in the report are results of near and far field intensity distributions, beam quality with and without jitter, jitter and beam spread measurements, and relative power measurements. Author (GRA)

N77-10528# Science Applications, Inc., Ann Arbor, Mich.
APPLICATION OF HIGH RESOLUTION SPECTROSCOPY TO DF LASER PROPAGATION Final Technical Report, 1 Mar. - 31 Aug. 1975
Douglas R. Woods and Robert E. Meredith Mar. 1976 61 p refs Prepared in cooperation with Michigan Univ., Ann Arbor
(Contract F30602-75-C-0028; AF Proj. 1279)
(AD-A023823; SAI-76-001-AA; RADC-TR-76-71) Avail: NTIS HC A04/MF A01 CSCL 20/5

Measurements have been made of the important HDO molecular absorption line parameters near a number of DF laser lines. While the line positions are in good agreement with the values given by the 'AFCRL Atmospheric Absorption Line Parameters Compilation,' there are significant differences for a number of the line strengths, and small differences for the particular line widths reported here. The new measured line parameters were used to calculate the atmospheric absorption of the above laser lines for various temperature and altitudes. Good agreement was obtained between these calculations and the available laboratory and field measurements of atmospheric absorption. Author (GRA)

N77-10529# Naval Research Lab., Washington, D.C.
LOW-ABSORPTION LASER WINDOWS Semiannual Report, period ending 31 Dec. 1975
P. H. Klein Apr. 1976 39 p refs
(ARPA Order 3066)
(AD-A024018; NRL-MR-3266; SAR-1) Avail: NTIS HC A03/MF A01 CSCL 20/5

This semiannual report summarizes work by NRL under ARPA Order 3066. Improvements have continued in methods for preparation, surface finishing, and characterization of low-loss laser-window materials. Calorimetric absorption studies included measurements of eight alkali and alkaline earth halides at 1.06 micrometers and of calcium fluoride, zinc selenide, and several alkali halides at 2.7, 3.8, and 10.6 micrometers. Adequate surface preparation virtually eliminates detectable surface absorption. Carbon tetrachloride is the most effective reactive halide for purification of potassium bromide, which was shown by bulk absorption coefficients for KBr as low as 0.000003 per centimeter at 1.06 micrometers and 0.000014 per centimeter at 10.6 micrometers (but nevertheless 0.0001 to 0.0002 per centimeter at 2.7 and 3.8 micrometers) and by the absence of metaborate ions in the crystals. A polishing method analogous to that for KCl was found effective for KBr, resulting in pit-free surfaces stable to room air for over a week, especially for surfaces remote from cleavage planes. Appended to this report is an abstract of a Navy-sponsored paper which compares crack propagation in alkali halides with that in alkaline earth fluorides. Future studies (for which some crystals have been prepared) will involve purification of strontium fluoride, additive strengthening of potassium chloride and potassium bromide, and testing of an evacuated calorimeter. Author (GRA)

N77-10530# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
A REVIEW OF RATE COEFFICIENTS IN THE H2-F2 CHEMICAL LASER SYSTEM Interim Report
Norman Cohen and Jerry F. Bott 15 Apr. 1976 103 p refs
(Contract F04701-75-C-0076)
(AD-A024332; TR-0076(6603)-2; SAMSO-TR-76-82) Avail: NTIS HC A06/MF A01 CSCL 20/5

In recent years, considerable effort has been expended at The Aerospace Corporation Aerophysics Laboratory to design theoretical models for computer calculations of the behavior and performance of HF chemical lasers, both pulsed and continuous. In order to perform such calculations, the rate coefficients of the various chemical reactions and energy transfer processes that occur must be known, or at least estimated. To this end, the Chemical Kinetics Department has attempted to maintain an up-to-date compilation of the rate coefficients that reflects the best current information available from published and unpublished theoretical and experimental work. When direct information has not been available, theoretical techniques for estimating rate coefficients based on various a priori principles or estimates based on comparison with related reactions with known rate coefficients are applied. Author (GRA)

N77-10531# United Technologies Research Center, East Hartford, Conn.
INVESTIGATION OF FINE-SCALE THREE-DIMENSIONAL CHEMICAL LASER: RESEARCH WORK ON ADVANCED CHEMICAL LASER NOZZLE TECHNOLOGY Final Report
A. I. Chalfant, T. J. Sadowski, M. D. Krosney, R. A. Meinzer, and R. V. Steele 30 Apr. 1976 144 p refs
(Contract N60921-74-C-0188)
(AD-A024317; UTRC/R76-911834-26) Avail: NTIS HC A07/MF A01 CSCL 20/5

An investigation of fine-scale three-dimensional chemical laser (HF/DF) nozzles was carried out. Under Task I three fine-scale cold reaction nozzles having different aerodynamic features were designed. Under Task II the 1-in. x 8-in. cold reaction nozzle fabricated in Task I was tested. The three fine-scale cold reaction segments fabricated in Task I were tested in Task III. A 1-in. segment of the fine scale chain reaction nozzle was also tested in Task III. Under Task IV theoretical analyses were carried out on the vibrational population distribution in the chain reaction nozzle and on the effect of alternative reactants on the performance of the cold reaction nozzle. Under Task V additional extensive tests of the 1-in. x 8-in. cold reaction nozzle were carried out to obtain a better correlation of the performance of this nozzle. Under Tasks VI and VII variable geometry cavity and diffuser walls with and without boundary layer injection were designed, fabricated and assembled. GRA

N77-10532# Frankford Arsenal, Philadelphia, Pa.
SELF-PHASE MODULATION: A REVIEW
Lloyd C. Bobb and Kimball Kramer Jan. 1975 15 p refs
(DA Proj. 1T1-61102-A-11D)
(AD-A024492; FA-TR-75074) Avail: NTIS HC A02/MF A01 CSCL 20/6

When a highly intense light pulse propagates through a medium, the electric field of the pulse can alter the index of refraction, which in turn, affects the propagation of the pulse. The time dependent index changes the phase of the wave which changes the temporal and spectral characteristics as well. The spectral broadening which occurs is called self-phase modulation or super broadening. There are a number of mechanisms which can contribute to the index variation: (1) direct electronic cloud distortion, (2) molecular reorientation, (3) molecular redistribution, and (4) librational motion of molecules. In the report self-phase modulation (SPM) is reviewed. A brief background is given and the process is described from a theoretical and experimental point of view. GRA

N77-10533# Acurex Corp., Mountain View, Calif. Aerotherm Div.
DESIGN AND FABRICATION OF A FINE ORIFICE INJECTOR Final Technical Report, Jan. 1973 - Jun. 1974
James E. Ferrell Aug. 1974 125 p refs
(Contract DAAH01-73-C-0370; DA Proj. 1T6-62703-A-308) (AD-A024219; AEROTHERM-74-112; RK-CR-75-9) Avail: NTIS HC A06/MF A01 CSCL 20/5

Based on specific operational constraints, a variety of nozzle design concepts for a deuterium fluoride chemical transfer laser were examined. A family of two-dimensional nozzles expanding in a plane perpendicular to the optical axis were identified to possess a variety of potential advantages particularly in reduction of shock interaction between nozzles and in alleviating fabrication problems. The liability associated with this reverse expansion concept is an inherent increase in nozzle length. Extensive analysis and nonreacting aerodynamic tests indicated that reverse expansion nozzles did maintain reasonable flow character despite the greater length. A complete nozzle array employing this concept has been fabricated for application to the Army DF-CO2 transfer chemical laser to determine the optical power extraction behavior of the concept. Author (GRA)

N77-10534# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
AIRBORNE LASER LABORATORY EXHAUST CHANNEL ACOUSTIC ANALYSIS Final Report, Jan. 1974 - Jul. 1975
William R. Conner Feb. 1976 90 p refs
(AF Proj. 317J)
(AD-A024211; AFFDL-TR-75-149) Avail: NTIS HC A05/MF A01 CSCL 20/5

A wind tunnel investigation was performed to determine the acoustic characteristics of two alternative exhaust channel configurations for the Airborne Laser Laboratory (ALL) gasdynamic laser. Models of the rectangular opening cavities were exposed to external flow in the Mach number range of 0.40 to 0.85 under the no-exhaust flow condition. Several shallow cavity resonance phenomena were identified in addition to both open and closed organ pipe deep cavity resonances. Both porous fence and low mass flow rate front lip blowing were found to be effective in resonance suppression. Author (GRA)

N77-10535# Air Force Geophysics Lab., Hanscom AFB, Mass.
LIGHT SHUTTER FOR LASER APPLICATIONS Instrumentation Papers
Robert L. Iliff 17 Mar. 1976 11 p refs
(AF Proj. 7600)
(AD-A024157; AFGL-TR-76-0059; AFGL-IP-247) Avail: NTIS HC A02/MF A01 CSCL 20/5

A novel light shutter for pulse chopping or mode-locked pulse selection is described. The approach is based on timing delays derived from cable length differences and light propagation time. Author (G.1A)

N77-10536# Illinois Univ., Urbana. Electro-Physics Lab.
FREQUENCY TUNABLE LASER SOURCES Final Report, 1 Feb. 1975 - 31 Jan. 1976
Paul D. Coleman 23 Feb. 1976 104 p refs
(Grant AF-AFOSR-1981-71; AF Proj. 9751)
(AD-A024259; UILU-ENG-76-2539; AFOSR-76-0511TR) Avail: NTIS HC A06/MF A01 CSCL 20/5

This annual report summarizes research done on (a) the study of guided waves in dielectric waveguides in the far IR along with prism and grating couplers, (b) the exploratory study of tunable laser signals in the far IR via collisionally broadened gain curves, (c) the development of inexpensive (approximately 1K$) IR lasers for optical pumping of molecules and (d) the study of tunable IR signals via coherent scattering from polariton modes in semiconductor crystals. GRA

N77-10537# Avco-Everett Research Lab., Everett, Mass.
OPTICAL TECHNIQUES FOR THERMAL FOCUSING Final Report, 30 Apr. 1974 - 30 Jan. 1976
E. A. Philips, G. W. Sutton, F. H. Scammell, and P. F. Kellen Mar. 1976 76 p refs
(Contract N60921-74-C-0289)
(AD-A023865) Avail: NTIS HC A05/MF A01 CSCL 20/5

A scaled laboratory analog of atmospheric thermal blooming of high energy laser propagation was constructed and used to investigate uniformly illuminated apertures, both square and circular with obscurations, and wedge intensity profiles for square apertures, including windward edge concave circular apertures. Cylindrical (astigmatic) corrections and refocusing were also investigated. Interferograms of the phase shift in the propagation path during thermal blooming referred to the input aperture were taken for square apertures, for axisymmetric Gaussian intensity profiles and for the circularly apodized wedge intensities. The unobscured square or circular aperture gave twice the central intensity for heavy blooming in comparison to an 'infinite' Gaussian. GRA

N77-10538# Illinois Univ., Urbana. Electro-Physics Lab.
EXCITATION AND RELAXATION STUDIES OF MOLECULAR LASERS Annual Report, 15 Feb. 1975 - 14 Feb. 1976
T. A. DeTemple Apr. 1976 75 p refs
(Grant NSF ENG-74-23677)
(PB-253669/6; UILU-ENG-76-2545) Avail: NTIS HC A04/MF A01 CSCL 20E

The development of a hybrid output mirror for optically pumped far infrared lasers is outlined. Use of this mirror permitted a detailed theoretical model for the laser to be developed which exhibited good agreement with experiments. The development of a metal vapor injection furnace has resulted in flow rates of 1 mMole/sec with subsequent run times of 45 minutes. This furnace is being investigated as a metal atom source for metal oxidation chemical lasers and for chemically formed electrically excited lasers. GRA

N77-10318*# Mississippi Univ., University.
ACOUSTICAL PROBLEMS IN HIGH ENERGY PULSED E-BEAMS LASERS
T. E. Horton and K. F. Wylie *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 963-973 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10370*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC MEASUREMENT TECHNIQUES
William W. Hunter, Jr. *In its* Advan. in Eng. Sci., Vol. 4 1976 p 1603-1614 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01 CSCL 20E

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N77-10539*# Oregon Univ. Health Sciences Center, Portland.
ELECTROPHORETIC CHARACTERIZATION OF ALDEHYDE-FIXED RED BLOOD CELLS, KIDNEY CELLS, LYNPHOCYTES AND CHAMBER COATINGS Final Report
Oct. 1976 111 p refs
(Contract NAS8-30887)
(NASA-CR-2755; M-177) Avail: NTIS HC A06/MF A01 CSCL 06A

Ground-based electrokinetic data on the electrophoresis flight experiment to be flown on the Apollo-Soyuz Test Project experiment MA-011 are stipulated. Aldehyde-fixed red blood cells, embryonic kidney cells and lymphocytes were evaluated by

anayltical particle electrophoresis. The results which aided in the interpretation of the final analysis of the MA-011 experiment are documented. The electrophoresis chamber surface modifications, the buffer, and the material used in the column system are also discussed. Author

N77-10540*# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
DYNAMIC RESPONSE OF CAVITATING TURBOMACHINES
Sheung-Lip Ng Aug. 1976 203 p refs
(Contracts NAS8-29313; NAS8-28046; N00014-76-C-0156) (NASA-CR-150036; E-183.1) Avail: NTIS HC A10/MF A01 CSCL 13I

Stimulated by the pogo instability encountered in many liquid propellant rockets, the dynamic behavior of cavitating inducers is discussed. An experimental facility where the upstream and downstream flows of a cavitating inducer could be perturbed was constructed and tested. The upstream and downstream pressure and mass flow fluctuations were measured. Matrices representing the transfer functions across the inducer pump were calculated from these measurements and from the hydraulic system characteristics for two impellers in various states of cavitation. The transfer matrices when plotted against the perturbing frequency showed significant departure from steady state or quasi-steady predictions especially at higher frequencies. Author

N77-10541*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF DEBRIS DENT ON EHD LUBRICATION
Lavern D. Wedeven 1975 30 p refs Presented at Joint Lubrication Conf., Boston, 5-7 Oct. 1976; sponsored by Am. Soc. of Lubrication Engr. and ASME
(NASA-TM-X-73457; E-8690) Avail: NTIS HC A03/MF A01 CSCL 13I

Film thickness measurements associated with a debris dent have been made with interferometry under static and dynamic conditons. The presence of a debris dent alters the shape of the inlet region so that the local film thickness at the leading edge of the dent can become substantially lower than the trailing edge. The pressure modifications associated with these local elastohydrodynamic (EHD) effects are in line with the frequent occurrence of surface initiated fatigue spalls originating at the trailing edge of debris dents. The effectiveness of the EHD mechanism in reducing the stress concentrations at the shoulders of the dent is related to inlet dimensions and dent size. Author

N77-10542# Brookhaven National Lab., Upton, N.Y.
CLOSED BRAYTON CYCLE USING HYDROGEN AS A WORK FLUID
J. R. Powell, F. J. Salzano, W. S. Yu, and J. Milau 1976 12 p refs Presented at the 1st World Hydrogen Energy Conf., Miami Beach, Fla., 1 Mar. 1976 Sponsored by ERDA
(BNL-20899; Conf-760304-9) Avail: NTIS HC A02/MF A01

A high efficiency power cycle is proposed which uses H2 gas as a working fluid in a regenerative closed Brayton cycle. The H2 gas is compressed by an absorption/desorption cycle on metal hydride (Fe TiH/sub x/) beds. Low temperature solar or geothermal heat (T approximately 100 C) is used for the compression process, and high temperature fossil or nuclear heat (T approximately 700 C) supplies the expansion work in the turbine. Typically, approximately 90 percent of the high temperature heat input is converted to electricity, while approximately 3 kW of low temperature heat is required per kW of electrical output. Author (ERA)

N77-10543# Nederlandse Scheeps-Studiecentrum TNO, Delft. Scheepsbouw Afdeling.
SOME EXPERIMENTS ON ONE-SIDED WELDING WITH VARIOUS BACKING MATERIALS. PART 3: MECHANIZED WELDING WITH FLUX CORED WIRE AND BRAIDED WIRE, HORIZONTAL POSITION
J. M. Vink (Metaalinst. TNO) Feb. 1975 14 p refs In DUTCH; ENGLISH summary
(NSR-Mededel-41-S; TDCK-66660) Avail: NTIS HC A02/MF A01; Ned. Scheepsstudiecentrum TNO, Delft DFI. 10

The application of self-shielded (that is without gas shielding) flux cored wire and of braided wire for mechanized one-sided welding with backing materials is dealt with. Butt welds were welded with commercially available welding wires and four different backing materials. This time also glass was used for backing. A series of selection experiments were carried out during which all combinations were tried. For this only the root passes were laid, at various values of current, voltage, and travel speed as well as with a number of variations in the joint configuration. The results with the no gas wires proved to be disappointing; those with the braided wire were more satisfying. Therefore, in the continued investigations, in which the joints were welded completely, only the braided wire was used, combined with the four backing types. The welds were examined radiographically, mechanically, and chemically. The quality of the welds met the requirements. The braided wire proved to be well suited for one-sided welding; removing the slag, however, is difficult, and the deposition rate is low compared to mechanized processes tested before. Author (ESA)

N77-10544# European Space Research and Technology Center, Noordwijk (Netherlands). Testing and Engineering Div.
INDICATION OF SURFACE ROUGHNESS ON ENGINEERING DRAWINGS
Paris ESA 1 Mar. 1976 16 p
(ESA-PSS-23-ESTEC-Iss-1) Avail: NTIS HC A02/MF A01

Surface finish can be defined as the degree of roughness of a surface after it has been machined. Indications are given as to how and with what symbols surface roughness should be specified on engineering drawings prepared by or for the European Space Agency. ESA

N77-10545# British Steel Corp., Sheffield (England).
ROOT-RUN TOUGHNESS IN MULTI-PASS MANUAL METAL-ARC WELDS
J. G. Garland, P. Terry, and J. G. Garland Apr. 1976 39 p refs
(PB-254198/5; GS/PROD/571/1/75/C) Avail: NTIS HC A03/MF A01 CSCL 13E

The fracture toughness of root-runs in high heat input multipass manual metal arc welds in high strength structural steels was examined. Low root-run toughness is caused by dynamic strain aging produced by the thermomechanical effect of successive weld runs used to complete a multipass weld joint, it is not changed by either steel composition of electrode selection and the attainment of better properties depends upon weld procedure control. Low root-run toughness is essentially inherent to all high heat input multipass welds since little influence can be exercised on the interstitial alloying elements responsible for it. GRA

N77-10546# British Steel Corp., Sheffield (England). Information Services.
RECENT DEVELOPMENTS IN THE RESISTANCE WELDING OF ZINC COATED STEELS
Apr. 1976 29 p Presented at a Seminar on Welding of Coated Steel, London, Nov. 1975
(PB-254193/6; SM/881/D) Avail: NTIS HC A03/MF A01 CSCL 11F

Two factors limit the widespread application of such materials; (1) the limited life of welding electrodes, and (2) difficulties in maintaining consistent weld quality. The various mechanisms operative in electrode wear are identified as surface alloying, electrode deformation, recrystallization, grain growth, cavitation, and erosion. A number of developments that have markedly reduced the problems associated with the welding of steel coated with zinc, lead, tin or aluminum, are discussed. GRA

N77-10261*# Naval Academy, Annapolis, Md.
IMPACT TENSILE TESTING OF WIRES
T. H. Dawson *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 319-326 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10262*# Southern Illinois Univ., Carbondale.
NUMERICAL DETERMINATION OF THE TRANSMISSIBILITY CHARACTERISTICS OF A SQUEEZE FILM DAMPED FORCED VIBRATION SYSTEM

Michael A. Sutton (Babcock and Wilcox Co.) and Philip K. Davis *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 327-338 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10283*# Toledo Univ., Ohio.
ELASTO-PLASTIC IMPACT OF HEMISPHERICAL SHELL IMPACTING ON HARD RIGID SPHERE
D. D. Raftopoulos and A. L. Spicer (Gen. Motors Corp.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 563-573 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10290*# General Motors Research Labs., Warren, Mich.
ANALYSIS OF PANEL DENT RESISTANCE
Chi-Mou Ni *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 653-663 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N77-10547# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
SPARE PARTS CALCULATIONS [CALCUL DES RECHANGES]
Gourden and Jouanneau 5 Aug. 1975 20 p In FRENCH
(LRBA-NT-24/75/BT) Avail: NTIS HC A02/MF A01

An analytical simplified formula is sought to determine the number of spare parts to be available at user premises taking into account the various repair hypotheses on time to repair, autarky, and defects on items in stock. ESA

N77-10548# European Space Research and Technology Center, Noordwijk (Netherlands). Product Assurance Div.
A SCREENING TEST METHOD EMPLOYING A THERMAL VACUUM FOR THE SELECTION OF MATERIALS TO BE USED IN SPACE
Paris ESA 1 Aug. 1976 15 p
(ESA-PSS-09/QRM-02T-ESTEC-Iss-2) Avail: NTIS HC A02/MF A01

A specification is given for the equipment and procedure to be employed when samples of materials intended for use in spacecraft are submitted to a screening test under vacuum at 125 C in the presence of a condensor at 25 C. Acceptance limits are stated. Author (ESA)

N77-10549# European Space Research and Technology Center, Noordwijk (Netherlands). Product Assurance Div.
SPECIFICATION FOR THE APPLICATION OF HUGHSON H 322 BLACK ELECTRICALLY CONDUCTIVE COATING
Paris ESA 1 Sep. 1975 10 p
(ESA-PSS-24/QRM-18P-ESTEC-Iss-1) Avail: NTIS HC A02/MF A01

Requirements for applying a black, electrically conductive coating to spacecraft structures are defined. The specification encompasses materials and equipment, storage and shelf life, safety and health precautions, surface cleaning, preparation and application of the coating, handling and storage of coated parts, and quality assurance provisions. ESA

N77-10550# Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
AN APPLICATION OF FAULT TREE ANALYSIS TO OPERATIONAL TESTING M.S. Thesis
Gordon Lee Rankin Jun. 1975 91 p refs
(Contract DAAG39-75-C-0095)
(AD-A024206) Avail: NTIS HC A05/MF A01 CSCL 15/5

The problem of designing an operational test for complex military systems is approached using fault tree analysis. Operational testing, as opposed to developmental testing, must encompass all the various systems, doctrines, organizations, hardwares, and personnel that impact upon the system. Fault tree analysis is suggested as a method of modeling the entire system for various critical issues. GRA

N77-10551# Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
STUDY TO EVALUATE RESULTS OF OPERATIONAL TESTS AND EVALUATIONS OF COMPLEX COMMAND AND CONTROL SYSTEMS Final Summary Report
Leslie G. Callahan, Jr., Douglas C. Montgomery, and Harrison M. Wadsworth Sep. 1975 38 p
(Contract DAAG39-75-C-0095)
(AD-A024202) Avail: NTIS HC A03/MF A01 CSCL 14/4

Many Army Operational test designs and evaluations presently rely on the Analysis of Variance (ANOVA) statistical technique which does not take into account the correlation or dependence between critical issue attributes or MOE. This is particularly true in the case of operational tests for command and control systems which utilize a complex large hierarchical attribute structure. Multivariate analysis of variance (MANOVA) offers a powerful statistical technique for subjectively or objectively taking into account the correlation or dependence between attributes. This technique has not been widely used because MANOVA techniques require lengthy and specialized computer programs, and there is no convenient and usable form for determining the statistical power of the test, i.e., the probability of rejecting the null hypothesis when it is false. This research overcomes these two limitations by adaptation of the BIOMEDICAL COMPUTER PROGRAMS (BMD) to the computational constraint, and by the development and validation of a new and efficient Monte Carlo procedure to determine the power of the tests. GRA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N77-10552*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MINIMUM-MASS DESIGN OF FILAMENTARY COMPOSITE PANELS UNDER COMBINED LOADS: DESIGN PROCEDURE BASED ON SIMPLIFIED BUCKLING EQUATIONS
W. Jefferson Stroud and Nancy Agranoff Washington Oct. 1976 53 p refs
(NASA-TN-D-8257; L-10770) Avail: NTIS HC A04/MF A01 CSCL 13M

An analytical procedure is presented for designing hat stiffened and corrugated panels made of composite material and subjected to longitudinal (in the direction of the stiffeners) compression and shear loadings. The procedure is based on nonlinear mathematical programming techniques and a simplified set of buckling equations. Design requirements considered are buckling, strength, and extensional and shear stiffness. The effects of specified thickness, variation of cross-section dimensions, stiffness requirements, local buckling boundary conditions, and the effect of combined compression and shear loadings are shown. Author

N77-10553# Council for Scientific and Industrial Research, Pretoria (South Africa). Geomechanics Div.
FINITE ELEMENT ANALYSIS OF TRANSVERSELY ISOTROPIC BODIES
W. L. VanHeerden Sep. 1975 18 p refs
(CSIR-ME-1407) Avail: NTIS HC A02/MF A01

Relationships between stress and strain for a transversely isotropic body are given. It is shown that these relationships can be included in an existing finite element program for isotropic bodies so that transversely isotropic bodies can also be analyzed. Author

N77-10554# Council for Scientific and Industrial Research, Pretoria (South Africa). Strength Mechanics Div.

SIGNALS ANALYSIS PROGRAM 4 (SAPG 4): COMPUTER SOFTWARE DEVELOPED FOR THE EXTRACTION OF VARIOUS SIGNAL PARAMETERS FROM FATIGUE INDUCING LOADING SPECTRA

J. T. D. Fritz Sep. 1975 105 p refs
(CSIR-ME-1408) Avail: NTIS HC A06/MF A01

Computer software was developed to extract various descriptive and counting parameters from any random loading spectrum. The theory and algorithms used in determining various spectrum parameters are described and information on the various input and output data formats is given. Author

N77-10555# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).

RESPONSE OF AN ELASTIC HALF-SPACE TO A MOVING NORMAL POINT LOAD

Abraham Ungar Oct. 1975 31 p refs
(CSIR-WISK-189) Avail: NTIS HC A03/MF A01

The motion of an elastic, homogeneous and isotropic half-space, excited by a normal point load traveling uniformly over the free surface was determined. Using the differential transform technique, exact expressions in terms of elementary functions were found for the displacements at any point of the half-space. The displacements appear as a superposition of primary waves, i.e. the waves that would exist if the medium were unbounded, and secondary waves account for the presence of the boundary. Author

N77-10556*# United Technologies Research Center, East Hartford, Conn.

AEROELASTIC ANALYSIS FOR HELICOPTER ROTOR BLADES WITH TIME-VARIABLE, NON-LINEAR STRUCTURAL TWIST AND MULTIPLE STRUCTURAL REDUNDANCY: MATHEMATICAL DERIVATION AND PROGRAM USER'S MANUAL Final Report

Richard L. Bielawa Oct. 1976 155 p refs
(Contract NAS1-10960; DA Proj. 1F1-61102-AH-45)
(NASA-CR-2638) Avail: NTIS HC A08/MF A01 CSCL 01C

The differential equations of motion for the lateral and torsional deformations of a nonlinearly twisted rotor blade in steady flight conditions together with those additional aeroelastic features germane to composite bearingless rotors are derived. The differential equations are formulated in terms of uncoupled (zero pitch and twist) vibratory modes with exact coupling effects due to finite, time variable blade pitch and, to second order, twist. Also presented are derivations of the fully coupled inertia and aerodynamic load distributions, automatic pitch change coupling effects, structural redundancy characteristics of the composite bearingless rotor flexbeam - torque tube system in bending and torsion, and a descr.,)tion of the linearized equations appropriate for eigensolution analyses. Three appendixes are included presenting material appropriate to the digital computer program implementation of the analysis, program G400. Author

N77-10557*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MODE 1 STRESS INTENSITY FACTORS FOR ROUND COMPACT SPECIMENS

Bernard Gross 1976 7 p refs Presented at Task Group E-24.01.12 of Comm. E-24 of the Am. Soc. for Testing and Mater., Philadelphia, 5 Oct. 1976
(NASA-TM-X-73472; E-8857) Avail: NTIS HC A02/MF A01 CSCL 20K

The mode 1 stress intensity factors were computed for round compact specimens by the boundary collocation method. Results are presented for ratios A sub T/R sub 0 in the range 0.3 to 0.8, where A sub t is the distance from the specimen center to the crack tip for a specimen of diameter 2R sub 0. Author

N77-10558*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPLICATION OF STRAINRANGE PARTITIONING TO THE PREDICTION OF MPC CREEP-FATIGUE DATA FOR 2 1/4 Cr-1Mo STEEL

James F. Saltsman and Gary R. Halford 1976 28 p refs Proposed for presentation at Winter Ann. Meeting of the Am. Soc. of Mechanical Engineers, New York, 5-10 Dec. 1976
(NASA-TM-X-73474) Avail: NTIS HC A03/MF A01 CSCL 13M

Strainrange partitioning is used to predict the long time cyclic lives of the metal properties council (MPC) creep-fatigue interspersion and cyclic creep-rupture tests conducted with annealed 2 1/4 Cr-1Mo steel. Observed lives agree with predicted lives within factors of two. The strainrange partitioning life relations used for the long time predictions were established from short time creep-fatigue data generated at NASA-Lewis on the same heat of material. Author

N77-10559*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TREATMENT OF MULTIAXIAL CREEP-FATIGUE BY STRAINRANGE PARTITIONING

S. S. Manson and G. R. Halford 1976 26 p refs Presented at the Winter Annual Meeting of the Am. Soc. of Mechanical Engineers, New York, 6-10 Dec. 1976
(NASA-TM-X-73488) Avail: NTIS HC A03/MF A01 CSCL 13M

Strainrange partitioning is a recently developed method for treating creep-fatigue interaction at elevated temperature. Most of the work to date has been on uniaxially loaded specimens, where as practical applications often involve load multiaxiality. It is shown how the method can be extended to treat multiaxiality through a set of rules for combining the strain components in the three principal directions. Closed hysteresis loops, as well as plastic and creep strain ratcheting are included. An application to hold-time tests in torsion will be used to illustrate the approach. Author

N77-10560# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

FINITE ELEMENT METHOD APPLIED TO BIDIMENSIONALLY STRESSED STRUCTURES

F. Cesari and P. Gheduzzi Jul. 1975 330 p In ITALIAN
(RT/ING-(75)14) Avail: ERDA Depository Libraries, HC $10.00

A two dimensional stress analysis of two plate elements has been performed by the finite element method: R-12 rectangular element nonconforming and T-21 triangular element conforming. Results from analyses of the R-12 and T-21 elements are compared from the convergence view point. ERA

N77-10561# California Univ., Livermore. Lawrence Livermore Lab.

COMPARISON OF METHODS OF SOLVING THE EARTHQUAKE RESPONSE OF STRUCTURES WITH FOUNDATION FLEXIBILITY M.S. Thesis

M. Zaslawsky 13 Jan. 1976 61 p refs
(Contract W-7405-eng-48)
(UCRL-51986) Avail: NTIS HC A04/MF A01

The common methods of structural analysis, direct integration, normal mode approach, response spectrum approach, and the Uniform Building Code, are discussed in general. A 9 node lumped mass beam structural model is analyzed on the basis of the four approaches on a CDC 7600 computer. Foundation flexibility as it effects the structural analysis is discussed on the basis of a real site and three categories of sites; soft, intermediate, and hard. The results show under what conditions the methods of analysis are equivalent, where and why the methods of analysis give different results, and the effect of soil structure interaction. ERA

N77-10562# Instituut TNO voor Bouwmaycrialen en Bouwconstructies, Delft (Netherlands).

THE INFLUENCE OF HYDROGEN IN PRESTRESSED STEEL ON THE HYDROGEN EMBRITTLEMENT SENSITIVITY, PART 3 [DE INVLOED VAN REEDS IN VOORSPANSTAAL AANWEZIGE WATERSTOF OP DE GEVOELIGHEID VAN WATERSTOFBROSHEID (III)]

W. L. Sluijter and L. vanYperen Jan. 1975 15 p In DUTCH; ENGLISH summary
(BI-75-1) Avail: NTIS HC A02/MF A01

The hydrogen embrittlement sensitivity of prestressed steel was determined. Probes of high quality steel (QP 170; diameter 4 mm) to be used in prestressed concrete were saturated with

hydrogen by polarizing the steel wires for 2 hrs in a 20% ammonium-thiocyanate solution in water at -1200 mV (s.c.e.). Directly afterwards the ammonium-thiocyanate solution was replaced by a cement sand mortar (Rilem) while at the same time the wires were mechanically loaded up to 80% of the breakstrength. The time up to fracture was recorded, and the results were compared with other results where the wires remained in the same (cyanate) solution or where the wires were exposed to the laboratory air. It appeared that the presence of the mortar strongly diminished the sensitivity to hydrogen embrittlement. A possible theoretical explanation is given. Author (ESA)

N77-10563# California Univ., Berkeley. Earthquake Engineering Research Center.

ANALYSIS AND DESIGN OF TUBE-TYPE TALL BUILDING STRUCTURES

Hendrick deClercq and Braham H. Powell Feb. 1976 210 p refs

(PB-252220/9; EERC-76-5) Avail: NTIS HC A10/MF A01 CSCL 13M

A method, called the macroelement method, is presented for the approximate analysis of three-dimensional tube-type frames consisting of horizontal beams and vertical columns connected at rigid joints. The macroelement method is a variation of the finite element method, in which a single element embraces a rectangular portion of frame consisting of several columns and several beams. Shape functions are assumed over the region of each element to express the displacements of the beam-column joints in terms of the displacements of the nodes. Numerical results are presented to show that an analysis by this method can yield results which are close to those obtained by an exact analysis, using a fraction of the computer time. GRA

N77-10564# ENSCO, Inc., Springfield, Va. Transportation and Instrumentation Sciences Div.

AUTOMATION OF THE SCHONFELD METHOD OF HIGHWAY SURFACE TEXTURE CODE ASSIGNMENT. VOLUME 1: THREE DIMENSIONAL CLASSIFICATION TECHNIQUE INTRODUCTION AND SUMMARY, PHASE 1 Final Report, Sep. 1974 - Aug. 1975

E. Howerter and J. Rudd Aug. 1975 51 p refs Sponsored in part by Maryland State Highway Administration, Brooklandville

(PB-254827/9; FHWA-MD-R-76-8A-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 13B

Electronic stereophotogrammetric techniques were adapted to obtain data defining the surface from stereophotographs. Algorithms were then developed to process this data on a computer and classify the surface texture automatically. Preliminary designs of camera systems, which could be mounted on a highway vehicle and collect the required data, were developed and shown to be feasible. The automated procedure allows a much more comprehensive and detailed investigation of surface texture to be carried out than the previously available manual method. GRA

N77-10565# ENSCO, Inc., Springfield, Va. Transportation and Instrumentation Sciences Div.

AUTOMATION OF THE SCHONFELD METHOD OF HIGHWAY SURFACE TEXTURE CODE ASSIGNMENT. VOLUME 2: THREE DIMENSIONAL CLASSIFICATION TECHNIQUE TECHNICAL APPROACH Final Report on Phase 1, Sep. 1974 - Aug. 1975

E. Howerter, J. Rudd, and M. Aronstein Aug. 1975 396 p refs Sponsored in part by Maryland State Highway Administration, Brooklandville

(PB-254828/7; FHWA-MD-R-76-8B-Vol-2) Avail: NTIS HC A17/MF A01 CSCL 13B

The volume contains details of the technical approach followed to classify the pavement texture samples in accordance with the Schonfeld methodology. GRA

N77-10566# ENSCO, Inc., Springfield, Va. Transportation and Instrumentation Sciences Div.

AUTOMATION OF THE SCHONFELD METHOD OF HIGHWAY SURFACE TEXTURE CODE ASSIGNMENT. VOLUME 3: THREE DIMENSIONAL CLASSIFICATION TECHNIQUE. APPENDIXES, PHASE 1 Final Report, Sep. 1974 - Aug. 1975

E. Howerter, J. Rudd, and M. Aronstein Aug. 1975 224 p Sponsored in part by Maryland State Highway Administration, Brooklandville

(PB-254829/5; FHWA-MD-R-76-8C-Vol-3) Avail: NTIS HC A10/MF A01 CSCL 13B

Contents: Standard flowcharting symbols and programming conventions; Program listings; Schonfeld results obtained for the selected pavement texture samples using the manual stereointerpretation technique; Final statistical matrices for the selected pavement texture samples. GRA

N77-10567# New Jersey State Dept. of Transportation, Trenton. Div. of Research and Development.

PAVEMENT PATCHING TECHNIQUES AND MATERIALS Final Report

G. Indahl, J. Quinn, and K. Afferton Jun. 1975 102 p Prepared in cooperation with Federal Highway Admin., Washington, D.C.

(PB-253342/0; Rept-75-010-7742) Avail: NTIS HC A06/MF A01 CSCL 13C

A study was conducted to find materials suitable for rapid, relatively long lasting economical winter patching of portland cement and bituminous concrete pavements; and to develop efficient techniques necessary for their placement. Overall, the standard winter mix (RR) performed very well as compared to the other materials tested. It was also the most costs effective of the cold winter mixes used. The effect of weather, traffic volume, and the various compaction and pothole preparation techniques on patch durability, are also discussed. GRA

N77-10568# Virginia Highway and Transportation Research Council, Charlottesville.

EVALUATION OF SEVERAL TYPES OF CURING AND PROTECTIVE MATERIALS FOR CONCRETE. PART 4: PERFORMANCE Final Report

Howard H. Newlon, Jr. Aug. 1975 42 p refs

(PB-252404/9; VHTRC-76-R5-Pt-4) Avail: NTIS HC A03/MF A01 CSCL 13C

Various curing and/or protective coatings were evaluated. It is concluded that: (1) properly entrained air is overwhelmingly the most effective defense against scaling; (2) when insufficient entrained air is obtained, linseed oil treatments delay the onset of scaling but do not prevent it; (3) materials intended to cure and protect in a single application are not effective; and, (4) linseed oil treatments applied after curing with membrane curing are effective without prior removal of the curing compound.GRA

N77-10569# Michigan Dept. of State Highways and Transportation, Lansing. Research Lab.

DEVELOPMENT OF PROCEDURES FOR REPLACING JOINTS IN CONCRETE PAVEMENT Progress Report, Jul. 1971 - Jul. 1975

J. E. Simonsen Aug. 1975 111 p refs Sponsored in part by Federal Highway Admin.

(PB-254797/4; R-968) Avail: NTIS HC A06/MF A01 CSCL 13B

Two types of concrete pavement repair procedures were developed; pre-cast slab repairs and cast-in-place repairs, both requiring full-depth sawing of the repair limits, removal of the distressed concrete without disruption of the base, and installing sealed joints at the end limits. To date, repairs equivalent to approximately 7 lane miles of pavement were made. No specific repair recommendations are made, since evaluation of the repairs is not complete. An Appendix, containing a step-by-step repair procedure, current Michigan Specifications, and various plans, is included. GRA

N77-10570# Materials Research and Development, Inc., Rockville, Md.

DETERMINATION OF STATISTICAL PARAMETERS. PHASE 2: CONCRETE PAVEMENT AND STRUCTURES Final Research Report, Sep. 1973 - Apr. 1975

S. B. Hudson and F. J. Bowery Jul. 1975 135 p refs Prepared in cooperation with Federal Highway Admin., Washington, D.C., Pa. Dept. of Transportation

(PB-254248/8; MAT-RES-DEV-WGAI-75-735-2) Avail: NTIS HC A07/MF A01 CSCL 13B

The work involved (1) the drafting of trial specifications, (2)

the random sampling and testing of pavement and structure concrete on a statewide basis, and (3) the revision of the trial specifications as required by the findings of the random sampling. Concrete samplings were made on 35 projects distributed over eight counties. Random samplings included 165 of structure concrete and 297 of pavement concrete. To facilitate analysis, the statistical parameters of measurements made on all samples were obtained from the data by means of computer programs specifically developed for the purpose. Field measurements of slump and air content were made on all samples. GRA

N77-10571# West Virginia Dept. of Highways, Charleston.
ROAD TEST RESEARCH OF SKID RESISTANT BITUMINOUS SURFACES Final Report
John R. OLeary and Robert G. Ward Dec. 1975 136 p refs
(PB-253920/3; WVDOH-35; FHWA-WV-76-1) Avail: NTIS HC A07/MF A01 CSCL 13B

Road test research of skid resistant bituminous surfaces on densities, texture (stereo-photographs) road profiles, and visual observations is reported. Periodic skid tests were conducted. The skid numbers declined considerably during the first year; then became cyclical, i.e., high in the winter and spring and low in the fall. The skid resistance of the limestone paving mixes was found to be unsatisfactory. Of those mixes made with other commonly used aggregates, high skid resistance was usually accompanied by poor durability. Some of these mixes did not last the duration of the project. Exceptions are synopal and metallurgical slag, which are found to be both skid resistant and durable. GRA

N77-10572# Lehigh Univ., Bethlehem, Pa. Engineering Lab.
LOW-CYCLE FATIGUE OF JOINED STRUCTURES Final Report
Lambert Tall Dec. 1974 18 p refs
(Contract N00014-68-A-0514; NR Proj. 064-509)
(AD-A023782) Avail: NTIS HC A02/MF A01 CSCL 13/5

The purpose of the project was to develop studies in the area of fatigue and fracture on an interdisciplinary basis, in particular, to study low-cycle fatigue, with particular emphasis on welded joints in high-strength steels. The welded joint was analyzed with respect to the state of stress and strain and metallurgical structure, and the mechanism of fatigue initiation and propagation was studied in welded joints of high-strength steels. GRA

N77-10573# Portland Cement Association, Skokie, Ill.
FATIGUE STRENGTH OF HIGH-YIELD REINFORCING BARS Final Report
Thorsteinn Helgason, John M. Hanson, Norman F. Somes, W. Gene Corley, and Eivind Hognestad Jun. 1976 104 p refs Sponsored by the Am. Association of State Highway and Transportation Officials and the Federal Highway Admin.
(PB-254506/9; TRB/NCHRP/REP-164; ISBN-0-309-02430-7) Avail: NTIS HC A06/MF A01 CSCL 11F

The fatigue strength of high yield reinforcing bars (generally Grades 60 and 75) was investigated. A statistically valid experiment was performed employing 353 fatigue tests on concrete beams, each containing one reinforcement bar. Test results were entered in an over-all multiple linear regression analysis. The major effects studied were stress range, minimum stress, bar diameter, type of specimen, grade of bar, and bar geometry. On the basis of the observed behavior, a fatigue design provision was developed for deformed reinforcing bars, suggesting a limitation on the service load stress range. GRA

N77-10574# Watervliet Arsenal, N.Y.
THE STANDARD LINEAR MODEL IN A VISCOELASTIC LAMINATED COMPOSITE BEAM THEORY
C. R. Thomas Apr. 1976 40 p refs
(AD-A023902; WVT-TR-76010) Avail: NTIS HC A03/MF A01 CSCL 20/11

A microstructure or effective stiffness viscoelastic laminated beam theory is derived where individual reinforcing and matrix layers are modeled as viscoelastic Timoshenko beams. Kinetic, potential and dissipative energies are determined for individual beam layers modeled as viscoelastic Timoshenko beams with constitutive equations given by the standard linear model. The individual energies are summed over the layers in the beam, a smoothing operation is applied and an energy principle is applied to yield the equations of motion and boundary conditions for a viscoelastic laminated beam theory. Author (GRA)

N77-10575# National Bureau of Standards, Washington, D.C.
MEAN SPEED PROFILES OF HURRICANE WINDS Final Report
Emil Simiu, Virendra Patel (Iowa Univ., Iowa City), and John F. Nash (Sybucon, Inc., Atlanta, Ga.) 24 Jun. 1975 10 p refs Repr. from J. of the Engineering Mechanics Div., vol. 102, no. Em2, Apr. 1976 p 265-273
(PB-252775/2) Avail: NTIS HC A02/MF A01 CSCL 13M

A numerical solution of the hurricane boundary layer problem is presented in which the hurricane is modeled as a steady, axisymmetric, neutrally stratified flow. The turbulence effects in the flow are accounted for by the phenomenological relations proposed by Bradshaw et al. and Nash, which provide a considerably more realistic picture of the actual flow than the pseudolaminar model used in previous solutions of the boundary layer problem. The results of the calculations obtained on the basis of the model just described suggest that: (1) in the height range of interest to the structural designer, say up to a height of 400 m above ground, it is permissible to use the the logarithmic law to represent the mean velocity profile of hurricane winds and (2) if the relation between wind speeds in different roughness regimes which obtains in extratropical storms is applied to hurricane winds, the speeds over built-up terrain, calculated as functions of speed over open terrain, may be underestimated by about 10% and 10-20% in suburban and in urban exposure, respectively. The corresponding mean loads are then underestimated by about 15% and 30%, respectively. GRA

N77-10576# Transportation Research Board, Washington, D.C.
PAVEMENT DESIGN, PERFORMANCE, AND REHABILITATION
R. K. Kher 1976 162 p refs
(PB-255634/8; TRB/TRR-572; ISBN-0-309-02485-4) Avail: NTIS HC A08/MF A01 CSCL 13B

The design, performance, and rehabilitation of both concrete and asphalt pavements are described. A significant development in recent years has been the application of systems concepts of pavement design and management. Pavement design and management systems consist of coordinated sets of activities or subsystems that should produce an optimum design strategy for a given set of circumstances. These systems may include subsystems for inputs, such as traffic and materials properties, for structural thickness selection, and for selection of an optimal design strategy including possible future rehabilitation activities. Three papers in this record deal with fairly complete subsystems. Others deal with certain phases of the many activities involved. GRA

N77-10577# Mathematical Applications Group, Inc., Elmsford, N.Y.
A SECOND ORDER NUMERICAL CODE FOR PLANE FLOW APPROXIMATION OF OBLIQUE IMPACT Final Report
S. Z. Burstein and H. S. Schechter Mar. 1976 49 p
(Contract DAAD05-75-C-0740)
(AD-A023914; P-7110; BRL-CR-294) Avail: NTIS HC A03/MF A01 CSCL 19/4

This report describes modifications completed for the SMITE code in transforming the axisymmetric version to plane flow. Details of several test calculations are also presented. GRA

N77-10578# Mathematical Applications Group, Inc., Elmsford, N.Y.
FRACTURE MODELING IN THE SMITE CODE Final Report
S. Z. Burstein and H. S. Schechter Mar. 1976 28 p
(Contract DAAD05-75-C-0741)
(AD-A023687; P-7111; BRL-CR-295) Avail: NTIS HC A03/MF A01 CSCL 11/6

This report documents the incorporation of the Stanford Research Institute's NAG-FRAG model into the SMITE code, a second order, Eulerian finite difference scheme modeling elasto-plastic material response to impact. Sample computations are presented. Author (GRA)

N77-10579# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
A FINITE ELEMENT ANALYSIS OF THE EFFECTS OF BIAXIAL LOADING ON FRACTURE
James D. Lee and Harold Liebowitz Mar. 1976 43 p refs (Contract N00014-75-C-0946)
(AD-A024651) Avail: NTIS HC A03/MF A01 CSCL 11/6

A finite element analysis combining with series-type analytic solution around the crack tip has been carried out with the purpose to study the biaxial effects of a center-cracked specimen. The method adopted makes it possible to show not only numerically, but also analytically that the uniform biaxial loading does not affect the stress intensity factor, but it does affect the energy release rate and the path of maximum sigma sub theta theta. The effects of geometric parameters and boundary conditions are also shown. GRA

N77-10580# Pisa Univ. (Italy). Inst. of Aeronautics.
FATIGUE BEHAVIOUR OF STRINGERS IN STIFFENED PANELS Final Technical Report
A. Saluetti, A. Frediani, and E. Grassi Feb. 1976 56 p refs (Grant DA-ERO-124-74-G0042)
(AD-A023985) Avail: NTIS HC A04/MF A01 CSCL 13/13

The investigation reported upon in this report was undertaken to study methods for evaluating stringer fatigue endurance in riveted stiffened panels which crack in the sheet cover under constant amplitude fatigue loading. The methods are aimed to correlating the crack length in the sheet cover 1, at which a stringer begins to crack, with the load conditions, the relevant panel geometric dimensions and the type of material. Two different approaches have been tried, both based on the use of the Miner's rule. The first is based on the assumption that a stringer in a cracked stiffened panel resembles a lap joint as far as its fatigue behaviour is concerned. The proposed approaches were than evaluated on the basis of the results of fatigue tests on 59 riveted stiffened panels differing in geometric shape dimensions and load conditions. The panels were constructed of 2024-T3 and 7075-T6 aluminum alloys utilizing different types of stringers: single, double strip and formed section stringers. All the stringers were hand riveted to the sheet cover utilizing round head as well as machine countersunk rivets. The experimental data indicate that the 'lap-joint' approach work satisfactorily; on the contrary the other approach requires further improvement, particularly a better understanding of the rivet forces redistribution caused by local plastic deformation around some rivet hole. GRA

N77-10581# Israel Inst. of Tech., Haifa. Materials Mechanics Lab.
NUMERICAL CALCULATING OF LARGE ELASTIC-PLASTIC DEFORMATION OF BEAMS DUE TO DYNAMIC LOADING Interim Report, 1974 - 1975
A. Sperling and Y. Partom Dec. 1975 43 p refs
(Grant AF-AFOSR-2607-74; AF Proj. 9782)
(AD-A023948; MML-50; AFOSR-76-TR-0478:SR-8) Avail: NTIS HC A03/MF A01 CSCL 13/13

Numerical calculations were performed for two examples of the response of elastic-plastic beams subjected to dynamic loads. These were a simply supported, axially restrained beam under suddenly applied uniform pressure, and an axially restrained, clamped beam with a central mass that is impacted by a projectile. Large elastic-plastic deflections were considered, and the method of finite differences was used. Two different constitutive equations were assumed: the elastic-perfectly plastic relation, and a special elastic-viscoplastic strain hardening model. Analysis of the results included examining the interaction between the bending moment and the axial force, the variation of the axial force, bending moment and deflection with time, and the propagation velocities of the various phenomena during motion. Experiments were carried out in which a rifle projectile hit a central mass which had been fastened to a clamped beam. Comparison between the theoretical and experimental dynamic deflections shows good agreement for relatively short response times. Author (GRA)

N77-10239*# Illinois Univ., Chicago.
WAVE SPEEDS AND SLOWNESS SURFACE IN ELASTIC-PLASTIC MEDIA OBEYING TRESCA'S YIELD CONDITION
T. C. T. Ting *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 85-102 refs (For primary document see N77-10230 01-31)
(Grant DAAG29-76-G-0121)
Avail: NTIS HC A16/MF A01

N77-10249*# Lehigh Univ., Bethlehem, Pa.
INFLUENCE OF SPECIMEN BOUNDARY ON THE DYNAMIC STRESS INTENSITY FACTOR
E. P. Chen and G. C. Sih *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 205-214 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10250*# Georgia Inst. of Tech., Atlanta.
FINITE-ELEMENT ANALYSIS OF DYNAMIC FRACTURE
J. A. Aberson, J. M. Anderson, and W. W. King *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 215-225 refs (For primary document see N77-10230 01-31)
(Contract F08635-76-C-0136)
Avail: NTIS HC A16/MF A01

N77-10251*# State Univ. of New York, Stony Brook.
APPLICATION OF A NOVEL FINITE DIFFERENCE METHOD TO DYNAMIC CRACK PROBLEMS
Yung M. Chen and Mark L. Wilkins (Lawrence Livermore Lab) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 227-238 refs (For primary document see N77-10230 01-31)
(Contract W-7405-eng-48; Grant DAAG29-76-G-0197)
Avail: NTIS HC A16/MF A01

N77-10252*# Kentucky Univ., Lexington.
RAPID INTERFACE FLAW EXTENSION WITH FRICTION
L. M. Brock *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 239-246 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10253*# Iowa State Univ. of Science and Technology, Ames.
DYNAMIC DUCTILE FRACTURE OF A CENTRAL CRACK
Y. M. Tsai *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 247-256 refs (For primary document see N77-10230 01-31)
(Grant NSF ENG-74-08147)
Avail: NTIS HC A16/MF A01

N77-10254*# George Washington Univ., Washington, D.C.
A STUDY OF THE EFFECT OF SUBCRITICAL CRACK GROWTH ON THE GEOMETRY DEPENDENCE ON NONLINEAR FRACTURE TOUGHNESS PARAMETERS
D. L. Jones, P. K. Poulose, and H. Liebowitx *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 257-266 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10255*# Georgia Inst. of Tech., Atlanta.
ON A 3-D SINGULARITY ELEMENT FOR COMPUTATION OF COMBINED MODE STRESS INTENSITIES
Satya N. Atluri and K. Kathiresan *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol 1 1976 p 267-274 refs (For primary document see N77-10230 01-31)
(Grants AF-AFOSR-2667-74; NSF ENG-74-213469)
Avail: NTIS HC A16/MF A01

N77-10256*# Banaras Hindu Univ., Varanasi (India).
INFLUENCE OF A CIRCULAR HOLE UNDER UNIFORM NORMAL PRESSURE ON THE STRESSES AROUND A LINE CRACK IN AN INFINITE PLATE
Ram Narayan and R. S. Mishra *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 275-282 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10257*# Lehigh Univ., Bethlehem, Pa.
THE EFFECT OF SEVERAL INTACT OR BROKEN STRINGERS OF THE STRESS INTENSITY FACTOR IN A CRACKED SHEET
K. Arin *In* NASA. Langley Res. Center Advan. in Eng. Sci.,

Vol 1 1976 p 283-290 refs (For primary document see N77-10230 01-31)
(Grant NsG-1178)
Avail: NTIS HC A16/MF A01

N77-10258*# Lehigh Univ., Bethlehem, Pa.
ON THE PROBLEM OF STRESS SINGULARITIES IN BONDED ORTHOTROPIC MATERIALS
F. Erdogan and F. Delale *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol.1 1976 p 291-300 refs (For primary document see N77-10230 01-31)
(Grant NGR-39-007-011)
Avail: NTIS HC A16/MF A01

N77-10263*# Utah State Univ., Logan.
A MODEL STUDY OF LANDING MAT SUBJECTED TO C-5A LOADINGS
P. T. Blotter, F. W. Kiefer, and V. T. Christiansen *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 339-348 refs (For primary document see N77-10230 01-31)
(Contract F29601-73-C-0131)
Avail: NTIS HC A16/MF A01

N77-10266*# Illinois Univ., Chicago.
ON THE STABILITY OF A CLASS OF IMPLICIT ALGORITHMS FOR NONLINEAR STRUCTURAL DYNAMICS
Ted Belytschko *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 385-391 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10267*# Texas Univ., Austin.
A REVIEW OF SUBSTRUCTURE COUPLING METHODS FOR DYNAMIC ANALYSIS
Roy R. Craig, Jr. and Ching-Jone Chang *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 393-408 refs (For primary document see N77-10265 01-31)
(Grant NsG-1268)
Avail: NTIS HC A20/MF A01

N77-10268*# Akron Univ., Ohio.
CORIOLIS EFFECTS ON NONLINEAR OSCILLATIONS OF ROTATING CYLINDERS AND RINGS
Joseph Padovan *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 409-416 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10269*# California Univ., Livermore. Lawrence Livermore Lab.
ON THE EXPLICIT FINITE ELEMENT FORMULATION OF THE DYNAMIC CONTACT PROBLEM OF HYPERELASTIC MEMBRANES
J. O. Hallquist and W. W. Feng *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 417-424 refs (For primary document see N77-10265 01-31)
(Contract W-7405-eng-48)
Avail: NTIS HC A20/MF A01

N77-10270*# College of William and Mary, Williamsburg, Va.
FREE VIBRATIONS OF LAMINATED COMPOSITE ELLIPTIC PLATES
C. M. Andersen and Ahmed K. Noor (George Washington Univ.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 425-438 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10271*# Massachusetts Inst. of Tech., Cambridge.
SOME DYNAMIC PROBLEMS OF ROTATING WINDMILL SYSTEMS
John Dugundji *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 439-447 refs (For primary document see N77-10265 01-31)
(Grant NSF AER-75-00826)
Avail: NTIS HC A20/MF A01

N77-10272*# Argonne National Lab., Ill.
DYNAMIC INELASTIC RESPONSE OF THICK SHELLS USING ENDOCHRONIC THEORY AND THE METHOD OF NEARCHARACTERISTICS
Hsuan-Chi Lin *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 449-458 refs Sponsored by ERDA (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10273*# New Mexico State Univ., University Park.
VIBRATIONS AND STRESSES IN LAYERED ANISOTROPIC CYLINDERS
G. P. Mulholland and B. P. Gupta (Fluor Engineers and Constructors, Inc.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 459-472 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10274*# Tennessee Technological Univ., Cookeville.
INCREMENTAL ANALYSIS OF LARGE ELASTIC DEFORMATION OF A ROTATING CYLINDER
George R. Buchanan *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 473-480 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10275*# Technical Univ. of Istanbul (Turkey).
VARIATIONAL THEOREMS FOR SUPERIMPOSED MOTIONS IN ELASTICITY, WITH APPLICATION TO BEAMS
M. Cengiz Doekmeci *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 481-490 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10276*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESPONSE OF LONG, FLEXIBLE CANTILEVER BEAMS APPLIED ROOT MOTIONS
Robert W. Fralich *In its* Advan. in Eng. Sci., Vol. 2 1976 p 491-499 ref (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01 CSCL 13M

N77-10277*# Illinois Univ., Chicago.
OPTIMAL DESIGN AGAINST COLLAPSE AFTER BUCKLING
E. F. Masur *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 501-508 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10278*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
OPTIMUM VIBRATING BEAMS WITH STRESS AND DEFLECTION CONSTRAINTS
Manohar P. Kamat *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 509-519 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10279*# Washington Univ., St. Louis, Mo.
AN OPTIMAL STRUCTURAL DESIGN ALGORITHM USING OPTIMALITY CRITERIA
John E. Taylor (Michigan Univ.) and Mark P. Rossow *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 521-530 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10280*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
A RAYLEIGH-RITZ APPROACH TO THE SYNTHESIS OF LARGE STRUCTURES WITH ROTATING FLEXIBLE COMPONENTS
L. Meirovitch and A. L. Hale *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 531-542 refs (For primary document see N77-10265 01-31)
(Grant NsG-1114)
Avail: NTIS HC A20/MF A01

N77-10281*# Battelle Columbus Labs., Ohio.
THE STAGING SYSTEM: DISPLAY AND EDIT MODULE
Ed Edwards and Leo Bernier (AFFDL) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 543-553 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10284*# Tennessee Technological Univ., Cookeville.
LARGE DEFLECTIONS OF SHALLOW CONICAL MEMBRANE
Wen-Hu Chang and John Peddieson, Jr. *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 575-584 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10285*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
A PLANE STRAIN ANALYSIS OF THE BLUNTED CRACK TIP USING SMALL STRAIN DEFORMATION PLASTICITY THEORY
J. J. McGowan and C. W. Smith *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 585-594 refs (For primary document see N77-10265 01-31)
(Grant NSF GK-39922)
Avail: NTIS HC A20/MF A01

N77-10286*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GAUSSIAN IDEAL IMPULSIVE LOADING OF RIGID VISCOPLASTIC PLATES
Robert J. Hayduk *In its* Advan. in Eng. Sci., Vol. 2 1976 p 595-616 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01 CSCL 13M

N77-10287*# Virginia Univ., Charlottesville. Dept. of Applied Mathematics and Computer Science.
RECENT ADVANCES IN SHELL THEORY
James G. Simmonds *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 617-626 refs (For primary document see N77-10265 01-31)
(Grant NSF MPS-73-08650)
Avail: NTIS HC A20/MF A01

N77-10288*# Argonne National Lab., Ill.
FLUID-PLASTICITY OF THIN CYLINDRICAL SHELLS
Dusan Krajcinovic *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 627-637 refs Sponsored by ERDA (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10289*# Kentucky Univ., Lexington.
THERMAL STRESSES IN A SPHERICAL PRESSURE VESSEL HAVING TEMPERATURE-DEPENDENT, TRANSVERSELY ISOTROPIC, ELASTIC PROPERTIES
T. R. Tauchert *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 639-651 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A30/MF A01

N77-10291*# Borg-Warner Corp., Chicago, Ill. Roy C. Ingersoll Research Center.
NEUTRAL ELASTIC DEFORMATIONS
Metin M. Durum *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 665-670 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10292*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY ON THE FORCED VIBRATION OF A TIMOSHENKO BEAM
Bucur Zainea *In its* Advan. in Eng. Sci., Vol. 2 1976 p 671-685 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01 CSCL 13M

N77-10294*# Texas Univ., Austin.
STRESS INTENSITY AT A CRACK BETWEEN BONDED DISSIMILAR MATERIALS
Morris Stern and Chen-Chin Hong *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 699-709 refs Sponsored by NSF (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10295*# Georgia Inst. of Tech., Atlanta.
STRESS CONCENTRATION FACTORS AROUND A CIRCULAR HOLE IN LAMINATED COMPOSITES
C. E. S. Ueng *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 711-720 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10324*# Massachusetts Inst. of Tech., Cambridge.
THE PREDICTION AND MEASUREMENT OF SOUND RADIATED BY STRUCTURES
Richard H. Lyon and J. Daniel Brito *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1031-1042 (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10325*# Massachusetts Inst. of Tech., Cambridge. Acoustics and Vibration Lab.
ON THE RADIATION OF SOUND FROM BAFFLED FINITE PANELS
Patrick Leehey *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1043-1055 refs Sponsored by Navy (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10326*# Princeton Univ., N.J.
ACOUSTOELASTICITY
Earl H. Dowell *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1057-1070 refs (For primary document see N77-10305 01-31)
(Grant NsG-1253)
Avail: NTIS HC A20/MF A01

N77-10327*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SOUND RADIATION FROM RANDOMLY VIBRATING BEAMS OF FINITE CIRCULAR CROSS SECTION
M. W. Sutterlin and A. D. Pierce (Ga. Inst. of Technol.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1071-1081 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10335*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER IN THE WIND TUNNEL FOR MODELING OF WIND LOADS ON LOW-RISE STRUCTURES
Henry W. Tieleman, Timothy A. Reinhold, and Richard D. Marshall (NBS, Washington, D. C.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1167-1176 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10336*# California Univ., Livermore. Lawrence Livermore Lab.
NUMERICAL SIMULATION OF TORNADO WIND LOADING ON STRUCTURES
Dennis E. Maiden *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1177-1190 refs (For primary document see N77-10305 01-31)
(Contract W-7405-eng-48)
Avail: NTIS HC A20/MF A01

42 GEOSCIENCES (GENERAL)

N77-10582# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 377, PART 1. (PROMPT REPORTS). DATA FOR DECEMBER 1975 -

NOVEMBER 1975. EXPLANATION OF DATA REPORTS ISSUED AS NUMBER 366 (SUPPLEMENT) FEBRUARY 1975
Hope I. Leighton Jan. 1976 114 p
(PB-247137-377-1; SGD-377-Pt-1; NOAA-76021601) Avail: NTIS MF A01; HC National Climatic Center, Attn: Publications. Federal Bldg., Asheville, N. C. 28891. Subscription $34.00/year includes part 1 (prompt reports) and part 2 (comprehensive reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.50/copy for either part; $1.40 for the extra issue. CSCL 03B

Solar geophysical data gathered during November and December, 1975 are presented. Contained are data on: alert periods; daily solar indices; solar flares; solar radio waves; solar wind measurements; spacecraft observations, and inferred IP magnetic field polarities. GRA

N77-10583# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 377, PART 2. (COMPREHENSIVE REPORTS). DATA FOR JULY 1975 - JUNE 1975 AND MISCELLANEA. EXPLANATION OF DATA REPORTS ISSUED AS NUMBER 366 (SUPPLEMENT) FEBRUARY 1975
Hope I. Leighton, ed. Jan. 1976 40 p refs
(PB-247137-377-2; SGD-377-Pt-2; NOAA-76021602) Avail: NTIS MF A01; HC: National Climatic Center, Attn: Publications. Federal Bldg., Asheville, N. C. 28801. Subscription $34.00/year includes part 1 (prompt reports) and part 2 (comprehensive reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.50/copy for either part; $1.40 for the extra issue. CSCL 03B

Data on solar flares, solar radio waves, and solar corona are reported. Miscellaneous data which offers information on cosmic rays and transmission frequency ranges for October 1975 are presented. GRA

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

N77-10584* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
OPTICAL PROCESS FOR PRODUCING CLASSIFICATION MAPS FROM MULTISPECTRAL DATA Patent
Richard E. Haskell, inventor (to NASA) (Oakland Univ.) Issued 5 Oct. 1976 12 p Filed 30 Aug. 1974 Supersedes N74-32780 (12 - 22, p 2680) Sponsored by NASA
(NASA-Case-MSC-14472-1; US-Patent-3,984,671; US-Patent-Appl-SN-502138; US-Patent-Class-235-181; US-Patent-Class-340-146.3P; US-Patent-Class-340-146.3Q) Avail: US Patent Office CSCL 08B

A method of producing single-class and multi-class composite classification maps from multispectral data is provided. The multispectral data is transformed into a binary matrix format which is then encoded on an optical medium such as photographic film. The encoded data is holographically correlated with coded patterns representing selected spectral signatures to produce signal-class classification maps. Several single-class maps are optically superimposed to produce multi-class composite classification maps. Official Gazette of the U.S. Patent Office

N77-10585*# Texas Univ., Austin.
DEVELOPMENT AND APPLICATION OF OPERATIONAL TECHNIQUES FOR THE INVENTORY AND MONITORING OF RESOURCES AND USES FOR THE TEXAS COASTAL ZONE Quarterly Report, Mar. - May 1976
Peggy Harwood, Principal Investigator (General Land Office, Austin), Robert Finley, Samuel McCulloch (Texas Water Development Board, Austin), David Marphy (Texas Water Development Board, Austin), and Bill Hupp (Texas Water Development Board, Austin) Jun. 1976 47 p refs ERTS
(Contract NAS5-20986)
(E77-10001; NASA-CR-148843) Avail: NTIS HC A03/MF A01 CSCL 08F

The author has identified the following significant results. Image interpretation mapping techniques were successfully applied to test site 5, an area with a semi-arid climate. The land cover/land use classification required further modification. A new program, HGROUP, added to the ADP classification schedule provides a convenient method for examining the spectral similarity between classes. This capability greatly simplifies the task of combining 25-30 unsupervised subclasses into about 15 major classes that approximately correspond to the land use/land cover classification scheme.

N77-10586*# Agricultural Research Service, Weslaco, Tex.
SOIL, WATER, AND VEGETATION CONDITIONS IN SOUTH TEXAS Quarterly Progress Report, 13 Jul. - 13 Oct. 1976
Craig L. Wiegand, Harold W. Gausman, Ross W. Leamer, Arthur J. Richardson, James H. Everitt, and Alvin H. Gerbermann, Principal Investigators Oct. 1976 21 p refs ERTS
(NASA Order S-53876-AG)
(E77-10002; NASA-CR-148818; QPR-7) Avail: NTIS HC A02/MF A01 CSCL 08F

The author has identified the following significant results. Reflectance measurements with a field spectroradiometer on nine dates (between December 9 and April 8) during the growing season of two wheat varieties, Milam and Penjamo, showed that the reflectance curves had the characteristic shape of vegetated surfaces by 4 weeks after the emergence. Green light (0.55 micron) reflectance was maximal and between water absorption bands (1.65 and 2.2 microns) reflectance was minimal when green vegetation development was greatest. Computer classification was accomplished for 81,000 hectare coastal rangeland area for October 13 and December 10, 1975, overpass dates. A hard freeze occurred between these two dates and many of the deciduous woody species defoliated so that more light penetrated to the herbaceous understory in December than in October.

N77-10587*# Bureau of Reclamation, Denver, Colo.
USE OF THE LANDSAT-2 DATA COLLECTION SYSTEM IN THE COLORADO RIVER BASIN WEATHER MODIFICATION PROGRAM Final Report
Archie M. Kahan, Principal Investigator Feb. 1976 107 p refs ERTS
(NASA Order S-53881-A)
(E77-10003; NASA-CR-148974) Avail: NTIS HC A06/MF A01 CSCL 05B

The author has identified the following significant results. Many types of environmental sensors can be interfaced to the LANDSAT DCP. The LANDSAT field installations proved to be remarkably reliable, weather resistant, and cost effective units able to relay high quality data in near real time. The wind averaging system demonstrated the feasibility of transmitting averaged wind data, stored over a period of several hours, from a remote site.

N77-10588*# Minnesota State Planning Agency, St. Paul.
ERTS-B APPLICATIONS TO MINNESOTA RESOURCE MANAGEMENT Progress Report, 26 Jun. - 25 Sep. 1976
Joseph E. Sizer, Principal Investigator 15 Oct. 1976 81 p refs ERTS
(Contract NAS5-20985)
(E77-10004; NASA-CR-148975) Avail: NTIS HC A05/MF A01 CSCL 08B

The author has identified the following significant results. Well over half of the land cover change for 1969 - 1975 is directly related to mining activity in the Mesabi Range. Although land cover changes amount to only a few percent of the 28 quadrangeles, over 18 percent of the Kinney quadrangle land cover changed in six years. Recent land cover change has three major foci: (1) Kinney-Virginia area, (2)Silica-Kewatin-Pengilly--Hibbing-Dewey Lake area, and (3)Isaac Lake-Babbitt-Aurora area. These are listed in order of importance based upon quadrangle analysis and acreage of cover change.

N77-10589*# Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.
EXTENSIVE INVENTORY OF FOREST RESOURCES BY MULTISTAGE SAMPLING Progress Report, 7 Jun. - 6 Sep. 1976

Robert C. Aldrich, Robert W. Dana, and Edwin H. Roberts, Principal Investigators 22 Sep. 1976 4 p ERTS
(NASA Order S-54053-A)
(E77-10006; NASA-CR-148977; PR-6) Avail: NTIS HC A02/MF A01 CSCL 02F

There are no author-identified significant results in this report.

N77-10590*# Earth Satellite Corp., Washington, D.C.
APPLICATION OF LANDSAT-2 DATA TO THE IMPLEMENTATION AND ENFORCEMENT OF THE PENNSYLVANIA SURFACE MINING CONSERVATION AND RECLAMATION ACT Progress Report, 19 Jun. - 19 Sep. 1976
Orville R. Russell, Principal Investigator 19 Sep. 1976 5 p ERTS
(Contract NAS5-21998)
(E77-10007; NASA-CR-148978; C-1037-2-6) Avail: NTIS HC A02/MF A01 CSCL 08I

There are no author-identified significant results in this report.

N77-10591*# Texas A&M Univ., College Station. Remote Sensing Center.
SPECTRAL MEASUREMENT OF WATERSHED COEFFICIENTS IN THE SOUTHERN GREAT PLAINS Progress Report, 1 Jun. - 31 Aug. 1976
Bruce J. Blanchard, Principal Investigator Sep. 1976 27 p refs ERTS
(Contract NAS5-22534)
(E77-10008; NASA-CR-148979; RSC-3273-4) Avail: NTIS HC A03/MF A01 CSCL 20F

There are no author-identified significant results in this report.

N77-10592*# Environmental Research and Technology, Inc., Concord, Mass.
INVESTIGATION OF MESOSCALE CLOUD FEATURES VIEWED BY LANDSAT Final Report, Jan. 1975 - Jan. 1976
Paul E. Sherr, Principal Investigator, Pieter J. Feteris, Anthony S. Lisa, Clinton J. Bowley, Mary Grace Fowler, and James C. Barnes Sep. 1976 111 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-20804)
(E77-10009; NASA-CR-148980; P-0619) Avail: NTIS HC A06/MF A01 CSCL 04B

The author has identified the following significant results. Some 50 LANDSAT images displaying mesoscale cloud features were analyzed. This analysis was based on the Rayleigh-Kuettner model describing the formation of that type of mesoscale cloud feature. This model lends itself to computation of the average wind speed in northerly flow from the dimensions of the cloud band configurations measured from a LANDSAT image. In nearly every case, necessary conditions of a curved wind profile and orientation of the cloud streets within 20 degrees of the direction of the mean wind in the convective layer were met. Verficiation of the results by direct observation was hampered, however, by the incompatibility of the resolution of conventional rawinsonde observations with the scale of the banded cloud patterns measured from LANDSAT data. Comparison seems to be somewhat better in northerly flows than in southerly flows, with the largest discrepancies in wind speed being within 8m/sec. or a factor of two.

N77-10593*# Michigan State Univ., East Lansing.
ECONOMIC EVALUATION OF CROP ACREAGE ESTIMATION BY MULTISPECTRAL REMOTE SENSING
Lester V. Manderscheid, R. Nalepka, Principal Investigators (Environmental Res. Inst. of Michigan), Wayne Myers, Gene Safir, Douglas Ilhardt, J. Morgenstern (Environmental Res. Inst. of Michigan), and J. Sarno (Environmental Res. Inst. of Michigan) 1976 138 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-13332)
(E77-10010; NASA-CR-150976) Avail: NTIS HC A07/MF A01 CSCL 02C

The author has identified the following significant results. Photointerpretation of S190A and S190B imagery showed significantly better resolution with the S190B system. A small tendancy to underestimate acreage was observed. This averaged 6 percent and varied with field size. The S190B system had adequate resolution for acreage measurement but the color film did not provide adequate contrast to allow detailed classification of ground cover from imagery of a single date. In total 78 percent of the fields were correctly classified but with 56 percent correct for the major crop, corn.

N77-10594*# Department of Industry, London (England).
MESOSCALE ASSESSMENTS OF CLOUD AND RAINFALL OVER THE BRITISH ISLES
Eric C. Barrett, Principal Investigator, Colin K. Grant, and R. Harris Sep. 1976 53 p refs Sponsored by NASA and Dept. of Industry, London ERTS
(E77-10012; NASA-CR-148982; QR-4) Avail: NTIS HC A04/MF A01 CSCL 04B

There are no author-identified significant results in this report.

N77-10595*# Virginia Univ., Charlottesville. Dept. of Environmental Sceinces.
LANDSAT APPLICATION OF REMOTE SENSING TO SHORELINE-FORM ANALYSIS Quarterly Report, 2 Jun. - 1 Sep. 1976
Robert Dolan, Bruce Hayden, Jeffrey Heywood, Principal Investigators, Clark Hewitt, and Jeffrey Michel 28 Sep. 1976 32 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-20999)
(E77-10013; NASA-CR-148983) Avail: NTIS HC A03/MF A01 CSCL 08B

The author has identified the following significant results. LANDSAT imagery of the southern end of Assateague Island, Virginia, was enlarged to 1:80,000 and compared with high altitude (1:130,000) and low altitude (1:24,000) aerial photography in an attempt to quantify change in land area over a nine month period. Change in area and configuration was found with LANDSAT and low altitude photography. Change in configuration, but no change in area was found with high altitude photography. Due to tidal differences at time of image obtention and lack of baseline data, the accuracy of the LANDSAT measurements could not be determined. They were consistent with the measurements from the low altitude photography.

N77-10596*# Geological Survey, Reston, Va.
CARETS: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM. VOLUME 2, PARTS A AND B: NORFOLK AND ENVIRONS; A LAND USE PERSPECTIVE Final Report
Robert H. Alexander, Principal Investigator, Peter J. Buzzanell, Katherine A. Fitzpatrick, Harry F. Lins, Jr., and Herbert K. McGinty, III Sep. 1975 364 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS 13 Vol.
(NASA Order S-70243-AG)
(E77-10014; NASA-CR-148984) Avail: NTIS HC A16/MF A01 CSCL 08B

The author has identified the following significant results. The Norfolk-Portsmouth metropolitan statistical area in southeastern Virginia was the site of intensive testing of a number of land resources assessment methods. Land use and land cover data at three levels of detail were derived by manual image interpretation from both aircraft and satellite sources and used to characterize the 1,766 sq km (682 sq mi) area from the perspective of its various resource-related activities and problems. Measurements at level 1 from 1:100, 000 scale maps revealed 42 percent of the test area (excluding bays and estuaries) to be forest, 28 percent agriculture, 23 percent urban and built-up, 4 percent nonforested wetlands, and 2 percent water. At the same scale and level of detail, 10 percent of the area underwent change from one land use category to another in the period

1959-70, 62 percent of which involved the relatively irreversible change from forest or agriculture to urban uses.

N77-10597*# Geological Survey, Reston, Va.
CARETS: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM. VOLUME 3: TOWARD A NATIONAL LAND USE INFORMATION SYSTEM Final Report
Robert H. Alexander, Principal Investigators Sep. 1975 76 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-70243-AG)
(E77-10015; NASA-CR-148985) Avail: NTIS HC A05/MF A01 CSCL 08B

There are no author-identified significant results in this report.

N77-10598*# Geological Survey, Reston, Va.
CARETS: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM. VOLUME 5: INTERPRETATION, COMPILATION AND FIELD VERIFICATION PROCEDURES IN THE CARETS PROJECT Final Report
Robert H. Alexander, Principal Investigator, Peter W. DeForth, Katherine A. Fitzpatrick, Harry F. Lins, Jr., and Herbert K. McGinty, III Sep. 1975 115 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS 13 Vol.
(NASA Order S-70243-AG)
(E77-10016; NASA-CR-148986) Avail: NTIS HC A06/MF A01 CSCL 08B

The author has identified the following significant results. Level 2 land use mapping from high altitude aircraft photography at a scale of 1:100,000 required production of a photomosaic mapping base for each of the 48, 50 x 50 km sheets, and the interpretation and coding of land use polygons on drafting film overlays. To enhance the value of the land use sheets, a series of overlays was compiled, showing cultural features, county boundaries and census tracts, surface geology, and drainage basins. In producing level 1 land use maps from LANDSAT imagery, at a scale of 1:250,000 drafting film was directly overlaid on LANDSAT color composite transparencies. Numerous areas of change were identified, but extensive areas of false changes were also noted.

N77-10599*# Geological Survey, Reston, Va.
CARETS: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM. VOLUME 6: COST, ACCURACY AND CONSISTENCY COMPARISONS OF LAND USE MAPS MADE FROM HIGH-ALTITUDE AIRCRAFT PHOTOGRAPHY AND ERTS IMAGERY Final Report
Robert H. Alexander, Principal Investigator and Katherine A. Fitzpatrick Sep. 1975 63 p refs ERTS 13 Vol.
(NASA Order S-70243-AG)
(E77-10017; NASA-CR-148987) Avail: NTIS HC A04/MF A01 CSCL 08B

The author has identified the following significant results. Level 2 land use maps produced at three scales (1:24,000, 1:100,000, and 1:250,000) from high altitude photography were compared with each other and with point data obtained in the field. The same procedures were employed to determine the accuracy of the Level 1 land use maps produced at 1:250,000 from high altitude photography and color composite ERTS imagery. Accuracy of the Level 2 maps was 84.9 percent at 1:24,000, 77.4 percent at 1:100,000 and 73.0 percent at 1:250,000. Accuracy of the Level 1 1:250,000 maps was 76.5 percent for aerial photographs and 69.5 percent for ERTS imagery. The cost of Level 2 land use mapping at 1:24,000 was found to be high ($11.93 per sq km). The cost of mapping at 1:100,000 ($1.75) was about two times as expensive as mapping at 1:250,000 ($.88), and the accuracy increased by only 4.4 percent.

N77-10600*# Geological Survey, Reston, Va.
CARETS: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM. VOLUME 7: LAND USE INFORMATION AND AIR QUALITY PLANNING Final Report
Robert H. Alexander, Principal Investigator, Wallace E. Reed, and John E. Lewis Sep. 1975 100 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS 13 Vol.
(NASA Order S-70243-AG)
(E77-10018; NASA-CR-148988) Avail: NTIS HC A05/MF A01 CSCL 08B

The author has identified the following significant results. The pilot air quality system provided data for updating information on the sources of point and area emissions of SO2 and particulate matter affecting the Norfolk-Portsmouth area of Virginia for 1971-72 winter and the annual 1972 period. During the 1971-72 winter, estimated SO2 amounts over an area with a SW-NE axis in the central section of Norfolk exceeded both primary and secondary levels.

N77-10601*# Geological Survey, Reston, Va.
CARETS: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM. VOLUME 9: SHORE ZONE LAND USE AND LAND COVER; CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE Final Report
Robert H. Alexander, Principal Investigator, R. Dolan, B. P. Hayden, and C. L. Vincent Sep. 1975 55 p ERTS 13 Vol.
(NASA Order S-70243-AG)
(E77-10019; NASA-CR-148989) Avail: NTIS HC A04/MF A01 CSCL 08B

The author has identified the following significant results. Analysis of the land use and land cover maps provides a stratification of the CARETS shore area into regions which have a similar environmental organization. Different elements of the landscape are altered less frequently moving inland. Near the beach, higher frequency of monitoring is needed than is needed in the inland areas, including the marsh and estuarine areas.

N77-10602*# Geological Survey, Reston, Va.
CARETS: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM. VOLUME 10: ENVIRONMENTAL PROBLEMS IN THE COASTAL AND WETLANDS ECOSYSTEMS OF VIRGINIA BEACH, VIRGINIA Final Report
Robert H. Alexander, Principal Investigator, Peter J. Buzzanell, and Herbert K. McGinty, III Sep. 1975 20 p refs ERTS 13 Vol.
(NASA Order S-70243-AG)
(E77-10020; NASA-CR-148990) Avail: NTIS HC A02/MF A01 CSCL 08B

There are no author-identified significant results in this report.

N77-10603*# Geological Survey, Reston, Va.
CARETS: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM. VOLUME 11: POTENTIAL USEFULNESS OF CARETS DATA FOR ENVIRONMENTAL IMPACT ASSESSMENT Final Report
Robert H. Alexander, Principal Investigator and Peter J. Buzzanell Sep. 1975 78 p refs ERTS 13 Vol.
(NASA Order S-70243-AG)
(E77-10021; NASA-CR-148991) Avail: NTIS HC A05/MF A01 CSCL 08B

There are no author-identified significant results in this report.

N77-10604*# Geological Survey, Reston, Va.
CARETS: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM. VOLUME 12: USER EVALUATION OF EXPERIMENTAL LAND USE MAPS AND RELATED PRODUCTS FROM THE CENTRAL ATLANTIC TEST SITE Final Report
Robert H. Alexander, Principal Investigator and Herbert K. McGinty, III Sep. 1975 182 p refs ERTS 13 Vol.
(NASA Order S-70243-AG)
(E77-10022; NASA-CR-148992) Avail: NTIS HC A09/MF A01 CSCL 08B

The author has identified the following significant results. Recommendations resulting from the CARETS evaluation reflect the need to establish a flexible and reliable system for providing more detailed raw and processed land resource information as

well as the need to improve the methods of making information available to users.

N77-10605*# Geological Survey, Reston, Va.
CARETS: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM. VOLUME 13: UTILITY OF CARETS PRODUCTS TO LOCAL PLANNERS; AN EVALUATION Final Report
Robert H. Alexander, Principal Investigator, Stuart W. Bendelow, and Franklin F. Goodyear Sep. 1975 56 p ERTS 13 Vol.
(NASA Order S-70243-AG)
(E77-10023; NASA-CR-148995) Avail: NTIS HC A04/MF A01 CSCL 08B

There are no author-identified significant results in this report.

N77-10606*# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
MULTISPECTRAL COLOR PHOTOGRAPHY FOR MINERAL EXPLORATION BY THE REMOTE SENSING OF BIOGEOCHEMICAL ANOMALIES
Edward Yost Aug. 1975 147 p refs
(Grant NGR-33-151-007)
(NASA-CR-144811) Avail: NTIS HC A07/MF A01 CSCL 14E

Selected band multispectral photography was evaluated as a mineral exploration tool by detecting stress on trees caused by underground mineralization. Ground truth consisted of two test sites in the Prescott National Forest within which the mineralization had been established by a drilling program. Species of trees were categorized as background, intermediate, and anomalous based upon where they grew with respect to this underlying mineralization. Soil geochemistry and the metal content of ashed samples of the trees were studied in relation to the inferred locus of mineralization. Computer analysis of the reflectance spectra of mineralized trees confirmed that the relative percent reflectance differences of trees growing in anomalous areas was less than that of the same tree species growing in background areas. Author

N77-10607*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
WHEAT SIGNATURE MODELING AND ANALYSIS FOR IMPROVED TRAINING STATISTICS: SUPPLEMENT. SIMULATED LANDSAT WHEAT RADIANCES AND RADIANCE COMPONENTS Final Report, 15 May 1975 - 14 May 1976
W. A. Malila, R. C. Cicone, and J. M. Gleason May 1976 190 p refs
(Contract NAS9-14123)
(NASA-CR-151087; Rept-109600-66-F) Avail: NTIS HC A09/MF A01 CSCL 02C

Simulated scanner system data values generated in support of LACIE (Large Area Crop Inventory Experiment) research and development efforts are presented. Synthetic inband (LANDSAT) wheat radiances and radiance components were computed and are presented for various wheat canopy and atmospheric conditions and scanner view geometries. Values include: (1) inband bidirectional reflectances for seven stages of wheat crop growth; (2) inband atmospheric features; and (3) inband radiances corresponding to the various combinations of wheat canopy and atmospheric conditions. Analyses of these data values are presented in the main report. Author

N77-10608*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EVALUATION CRITERIA FOR SOFTWARE CLASSIFICATION INVENTORIES, ACCURACIES, AND MAPS
Robert R. JaYroe, Jr. Sep. 1976 27 p
(NASA-TM-X-73347) Avail: NTIS HC A03/MF A01 CSCL 05B

Statistical criteria are presented for modifying the contingency table used to evaluate tabular classification results obtained from remote sensing and ground truth maps. This classification technique contains information on the spatial complexity of the test site, on the relative location of classification errors, on agreement of the classification maps with ground truth maps, and reduces back to the original information normally found in a contingency table. Author

N77-10609*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NEAREST NEIGHBOR, BILINEAR INTERPOLATION AND BICUBIC INTERPOLATION GEOGRAPHIC CORRECTION EFFECTS ON LANDSAT IMAGERY
Robert R. JaYroe, Jr. Sep. 1976 28 p ref
(NASA-TM-X-73348) Avail: NTIS HC A03/MF A01 CSCL 05B

Geographical correction effects on LANDSAT image data are identified, using the nearest neighbor, bilinear interpolation and bicubic interpolation techniques. Potential impacts of registration on image compression and classification are explored. Author

N77-10610*# Perceptronics, Inc., Woodland Hills, Calif.
DEVELOPMENT OF SIGNAL PROCESSING ALGORITHMS FOR ULTRASONIC DETECTION OF COAL SEAM INTERFACES Final Report
Dennis D. Purcell and Moshe Ben-Bassat Aug. 1976 43 p refs
(Contract NAS8-31782)
(NASA-CR-150024; PFTR-1030-76-8) Avail. NTIS HC A03/MF A01 CSCL 08I

A pattern recognition system is presented for determining the thickness of coal remaining on the roof and floor of a coal seam. The system was developed to recognize reflected pulse echo signals that are generated by an acoustical transducer and reflected from the coal seam interface. The flexibility of the system, however, should enable it to identify pulse-echo signals generated by radar or other techniques. The main difference being the specific features extracted from the recorded data as a basis for pattern recognition. Author

N77-10611*# Ohio State Univ., Columbus. ElectroScience Lab.
PASSIVE MICROWAVE MAPPING OF ICE THICKNESS Final Report. Ph.D. Thesis
John J. Apinis and William H. Peake Aug. 1976 156 p refs
(Grant NsG-3005)
(NASA-CR-149104; FR-3892-2) Avail: NTIS HC A08/MF A01 CSCL 08B

Basic calculations are presented for evaluating the feasibility of a scanning microwave radiometer system for mapping the thickness of lake ice. An analytical model for the apparent brightness temperature as a function of ice thickness has been developed, and elaborated to include such variables as galactic and atmospheric noise, aspect angle, polarization, temperature gradient in the ice, the presence of transition layers such as snow, slush, and water, increased loss due to air inclusions in the ice layer, and the presence of multiple ice thicknesses within the antenna footprint. It was found that brightness temperature measurements at six or seven frequencies in the range of 0.4 to 0.7 GHz were required to obtain unambiguous thickness estimates. A number of data processing methods were examined. The effects of antenna beamwidth, scanning rate, receiver bandwidth, noise figure, and integration time were studied. Author

N77-10612*# Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.
RADAR BACKSCATTER PROPERTIES OF MILO AND SOYBEANS
T. F. Bush, Fawwaz T. Ulaby, and T. Metzler Oct. 1975 59 p refs
(Contract NAS9-10261)
(NASA-CR-151029; RSL-TR-177-59) Avail: NTIS HC A04/MF A01 CSCL 17I

The radar backscatter from fields of milo and soybeans was measured with a ground based radar as a function of frequency (8-18 GHz), polarization (HH and VV) and angle of incidence (0 deg-70 deg) during the summer of 1974. Supporting ground truth was gathered contemporaneously with the backscatter data. At nadir sigma deg of milo correlated highly, $r = 0.96$, with soil moisture in the milo field at 8.6 GHz but decreased to a value of $r = 0.78$ at a frequency of 17.0 GHz. Correlation

studies of the variations of sigma deg with soil moisture in the soybean fields were not possible due to a lack of a meaningful soil moisture dynamic range. At the larger angles of incidence, however, sigma deg of soybeans did appear to be dependent on precipitation. It is suggested this phenomenon was caused by the rain altering plant geometry. In general sigma deg of both milo and soybeans had a relatively small dynamic range at the higher angles of incidence and showed no significant dependence on the measured crop parameters. Author

N77-10613# Corps of Engineers, Waltham, Mass. New England Div.

OPERATION OF THE LANDSAT AUTOMATIC TRACKING SYSTEM

Timothy D. Buckelew May 1976 72 p refs

Avail: NTIS HC A04/MF A01

The procedure and operation of the LANDSAT tracking system are discussed. Instructions for the normal day-to-day operation are presented showing information needed for program modification, file maintenance and trouble shooting. M.C.F.

N77-10614*# Computer Sciences Corp., Huntsville, Ala.

A STUDY AND EVALUATION OF IMAGE ANALYSIS TECHNIQUES APPLIED TO REMOTELY SENSED DATA Final Report

R. J. Atkinson, B. V. Dasarathy, M. Lybanon, and H. K. Ramapriyan Oct. 1976 205 p refs

(Contract NAS8-32107)

(NASA-CR-150041) Avail: NTIS HC A10/MF A01 CSCL 05B

An analysis of phenomena causing nonlinearities in the transformation from Landsat multispectral scanner coordinates to ground coordinates is presented. Experimental results comparing rms errors at ground control points indicated a slight improvement when a nonlinear (8-parameter) transformation was used instead of an affine (6-parameter) transformation. Using a preliminary ground truth map of a test site in Alabama covering the Mobile Bay area and six Landsat images of the same scene, several classification methods were assessed. A methodology was developed for automatic change detection using classification/cluster maps. A coding scheme was employed for generation of change depiction maps indicating specific types of changes. Inter- and intraseasonal data of the Mobile Bay test area were compared to illustrate the method. A beginning was made in the study of data compression by applying a Karhunen-Loeve transform technique to a small section of the test data set. The second part of the report provides a formal documentation of the several programs developed for the analysis and assessments presented. Author

N77-10615*# Auburn Univ., Ala. Dept. of Electrical Engineering.

OPTICAL DATA PROCESSING STUDY Final Technical Report, 3 Feb. 1975 - 4 Oct. 1976

L. J. Pinson 12 Oct. 1976 73 p

(Contract NAS8-31223)

(NASA-CR-150042) Avail: NTIS HC A04/MF A01 CSCL 20F

An onboard coherent optical data processing system was designed to handle large information content of imagery at high speeds, reduce redundancy in picture transmission, and detect specific image features. Theoretically derived Fourier transform characteristics for simple but representative two dimensional images served as a basis for predicting expected features of actual target images. Fourier transformation and spatial filtering of coherent optical images was accomplished theoretically and in the laboratory. The effect of various parameters such as optical aperature, incidence angles, the transparency assumption, the thin lens approximation on resolution, and performance of the system are predicted and tested. Author

N77-10616*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GEOLOGICAL APPLICATIONS OF NIMBUS RADIATION DATA IN MIDDLE EAST

Lewis J. Allison Oct. 1976 ~106 p refs Submitted for publication

(NASA-TM-X-71207; X-901-76-164) Avail: NTIS HC A06/MF A01 CSCL 08G

Plateaus of Eocene limestone and exposed limestones escarpments, in Egypt and Saudi Arabia respectively, were indicated by cool brightness temperatures T sub B (less than 240 to 265 K) by the Nimbus 5 electrically scanning microwave radiometer (ESMR) over a 2-year period. Nubian sandstone, desert eolian sand and igneous metamorphic rocks were differentiated from these limestone areas by warm T sub B values (more than 265 to 300 K). Cool T sub B values in the form of a V were found over broad areas of the Nile Valley and in the western desert of central Egypt. Similar cool T sub B values were shown over limestone-dolomitic hills of the interior Homocline and the Hadramawt plateau of Saudi Arabia. Nimbus 5 and 6 ESMR T sub B values selectively identified intermediate dense rock types (limestone versus sandstone/granite) in the Lake Nasser region whose thermal inertia ranged from 0.035 to 0.06 cal cm to minus 2 C sec 1/2 to minus one half. Author

N77-10617# Instituto Geografico Militar, La Paz (Bolivia). Departamento Geofisico.

GRAVITY MEASUREMENTS IN BOLIVIA [MEDICIONES GRAVIMETRICAS EN BOLIVIA]

1974 190 p In SPANISH

Avail: NTIS HC A09/MF A01

Gravimetric work initiated by the IGM and IGB of Bolivia is reported. A brief historical sketch is given, along with numerous summaries in tabulated form of gravimetric data and calculations from various gravimetric stations in Bolivia. Work in the area of oil prospects and international relations is discussed. Gravimetric instruments used in the National Network are listed, and scale maps of Bouguer ree-air anomalies in Bolivia are included.

Transl. by B.B.

N77-10618# Comision Nacional del Espacio Exterior, Mexico City (Mexico).

DATA PROCESSING OF INFORMATION FROM REMOTE SENSORS IN MEXICO [PROCESSAMIENTO AUTOMATICO DE INFORMACION DE PERCEPCION REMOTA EN LA COMISION NACIONAL DEL ESPACIO EXTERIOR]

Munoz Alfonso E. Zarco 1974 43 p refs In SPANISH

Avail: NTIS HC A03/MF A01

A brief summary of various experiments and projects that show the potential of remote sensors applied to specific problems. Areas of application are; (1) agriculture, (2) geothermal resources, and (3) detection of salt content in soil and bodies of water.

Transl. by B.B.

N77-10619*# National Conference of State Legislatures, Washington, D.C.

NATIONAL CONFERENCE OF STATE LEGISLATURES' TASK FORCE ON USES OF SATELLITE REMOTE SENSING FOR STATE POLICY FORMULATION Final Report and Recommendations

Sally M. Bay 25 Aug. 1976 142 p Conf. held at Denver, 25 Aug. 1976

(Contract NASw-2943)

(NASA-CR-149098) Avail: NTIS HC A07/MF A01 CSCL 05A

The applications and limitations of the NASA LANDSAT Follow-on Program were reviewed. State legislators, legislative staff, and state earth resources program managers evaluated the following: (1) the proposed capabilities of the program; (2) existing satellite applications in use by state agencies; (3) existing federal and state legislation mandating natural resources related state programs; (4) inferred data needs of those programs; and (5) an analysis of the feasibility of the Follow-On Program to meet those needs. Author

N77-10620*# Texas Univ. Health Science Center, Houston.

REMOTE SENSING UTILITY IN A DISASTER STRUCK URBAN ENVIRONMENT Final Report

Marjorie Rush and Alfonso Holguin 1 Sep. 1976 55 p refs School of Public Health.

(Grant NGL-44-084-003)

(NASA-CR-149103) Avail: NTIS HC A04/MF A01 CSCL 05A

Six major public health areas which might be affected by a natural disaster were identified. The functions and tasks associated

with each area following a disaster. potential ways remote sensing could aid these functions, and the baseline data which would expedite problem solving associated with these functions are discussed. Author

N77-10621*# Texas Univ., Houston. School of Public Health.
POTENTIAL ROLE OF REMOTE SENSING IN DISASTER RELIEF MANAGEMENT
Marjorie Rush, Alfonso Holguin, and Sally Vernon [1976] 97 p refs
(Grant NGL-44-084-003)
(NASA-CR-149143) Avail: NTIS HC A05/MF A01 CSCL 05K

Baseline or predisaster data which would be useful to decision making in the immediate postdisaster period are suggested for the six areas of public concern along with guidelines for organizing these data. Many of these already exist in various agencies, but may not have compiled for use in emergency situations. Potential sources of these data have been identified. In order to fully assess the impact of a disaster on an area, information about its predisaster status must be known. Aerial photography is one way of acquiring and recording such data. Author

N77-10622# Materials Associates, Inc., Washington, D. C.
MATERIALS AVAILABILITY IN A CHANGING WORLD
James Boyd 1 Oct. 1975 45 p refs Sponsored by NSF
(PB-252456/9; NSF/RA/N-75-273) Avail: NTIS HC A03/MF A01 CSCL 05C

Materials shortages exist and will continue despite human effort; irrevocable laws of supply and demand reinforce this belief. The government through its agencies has set forth policies to eliminate waste while increasing production of life's essentials such as food and energy supplies. The United States Geological Survey estimates that four quadrillion tons of materials in the earth's crust can be reached by man using conceivable technology, but the translation of a geological discovery into an economic deposit (a reserve) requires expensive development. The burden upon science and technology is heavy; new supply sources must be discovered, new methods of materials extraction must be devised, and more effective use must be made of what then becomes available. GRA

N77-10623# Bureau of Mines, Amarillo, Tex. Helium Operations.
HELIUM RESOURCES OF THE UNITED STATES, 1973 Information Circular, 1976
B. J. Moore Mar. 1976 23 p refs
(PB-252473/4; BM-IC-8708) Avail: NTIS HC A02/MF A01 CSCL 10A

The helium resources of the nation are reported in four categories:(1) helium in storage; (2) helium in measured helium-rich natural gas reserves; (3) helium in measured helium-lean natural gas reserves, and (4) helium in indicated and undiscovered natural gas resources. GRA

N77-10624# Bureau of Mines, Washington, D.C.
MINERALS IN THE US ECONOMY: TEN-YEAR SUPPLY-DEMAND PROFILES FOR MINERAL AND FUEL COMMODITIES
Jul. 1975 102 p refs
(PB-252994/9; BM-SP-2-75) Avail: NTIS HC A06/MF A01 CSCL 08I

The Bureau of Mines has prepared supply-demand diagrams and tables to highlight the flow of minerals through the U.S. economy. The selected mineral supply-demand tables and flow diagrams comprise one output from the information and data collected and compiled by the Bureau of Mines on a continuing basis covering mineral production, consumption, prices, shipments, imports, exports, and stocks, as well as industry activities in all States and abroad. The 10-year data base terminates with 1973 figures because adequate world information was not available beyond that date. Moreover, 1974 was an anomalous year with respect to prices, supply, and demand for many commodities. GRA

N77-10625# RAND Corp., Santa Monica, Calif.
THE LONG-RUN MARGINAL COSTS OF ENERGY
Kent P. Anderson and James C. DeHaven Feb. 1975 277 p refs
(Grants NSF GI-44; NSF SIA-74-18660)
(PB-252504/6; R-1590-NSF; NSF/RA/N-75-225) Avail: NTIS HC A13/MF A01 CSCL 10A

The following areas (not necessarily in order of significance) were judged to be most important in the near-term national energy situation; crude oil production (lower-48, Alaskan, foreign), conveyance by pipeline and tanker, refining, and distribution; natural gas production (lower-48, Alaskan), transmission, and distribution; syncrude production from domestic shale, transmission, and refining; coal production (surface and underground eastern and western--high and low sulfur) and transportation; central station electric power generation (nuclear- and fossil-fueled), transmission, and distribution; and nuclear fuel. Component costs of each system are provided. GRA

N77-10626# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
THE SUPPLY OF COAL IN THE LONG RUN: THE CASE OF EASTERN DEEP COAL
Martin B. Zimmerman Sep. 1975 87 p refs
(Grant NSF SIA-73-07871-A02)
(PB-252642/4; MIT-EL-75-021) Avail: NTIS HC A05/MF A01 CSCL 08I

A methodology is developed for estimating long-run supply curves for coal. The method relies on engineering information and geological data and is applied to deep mining in the Eastern United States. Cost functions are estimated combining engineering and econometric procedures. Information on the geology of coal deposits is used in conjunction with the cost functions to estimate how costs will behave over time as output cumulates. The procedure is applied separately to low sulfur and high sulfur coal. GRA

N77-10627# National Weather Service, Silver Spring, Md. Office of Hydrology.
A POINT ENERGY AND MASS BALANCE MODEL OF A SNOW COVER
Eric A. Anderson Feb. 1976 173 p refs
(PB-254653/9; NOAA-TR-NWS-19; NOAA-76040701) Avail: NTIS HC A08/MF A01 CSCL 08L

The model is based on two equations. These are the snow cover energy balance equation and the equation for energy transfer within a snow cover. The snow cover is divided into finite layers. Implicit finite difference expression, based on the two equations, are written for each layer. This set of nonlinear finite difference equations is solved by use of the Newton-Raphson iteration technique. The model also includes mathematical representations of the densification of the snow and the retention and transmission of liquid-water. The results obtained with this energy balance model are compared to results obtained with a temperature index snow cover compared to nonlinearity. Author (GRA)

N77-10628# Cornell Univ., Ithaca, N.Y. Water Resources and Marine Sciences Center.
A REVIEW AND ANALYSIS OF SELECTED HYDROLOGIC MODELING CONCEPTS
J. L. Nieber, M. F. Walter, and R. D. Black Jun. 1976 72 p refs
(Contract DI-14-31-0001-5032)
(PB-254489/8; W76-09718; OWRT-A-061-NY(1)) Avail: NTIS HC A04/MF A01 CSCL 08H

Several selected hydrologic watershed runoff models commonly used for forecasting floods and water supply were analyzed. The three approaches to hydrologic modeling, deterministic, parametric, and stochastic, are compared to emphasize the advantages and disadvantages of each. A review of the literature gives the general development of rainfall excess routing techniques, infiltration and evaporation determination techniques and techniques for estimating groundwater flow. Approaches of integrating these process submodels into a total watershed runoff model are considered. Several selected watershed modeling packages are discussed relative to origin, concept, and usefulness. GRA

N77-10629# Geological Survey, Tallahassee, Fla. Water Resources Div.

THE SHALLOW AQUIFER: A PRIME FRESHWATER RESOURCE IN EASTERN PALM BEACH COUNTY, FLORIDA Final Report

H. G. Rodis and L. F. Land Feb. 1976 17 p refs Sponsored by Palm Beach County Board of Commissioners, Fla., Central Fla. Flood Control District, and Southern Fla., Flood Control District

(PB-254393/2; USGS-WRD-WRP-76-038; USGS-WRI-76-21) Avail: NTIS HC A02/MF A01 CSCL 08H

The shallow aquifer underlies all of Palm Beach County and is the source of almost all freshwater supplies in the eastern part of the county. It consists of mixtures of sand, shell sandstone, and limestone. In this area the concentration of dissolved solids in the ground water usually does not exceed 500 milligrams per litre. A section of cavity-riddled limestone and other permeable rocks is located several miles inland and extends north to south almost the entire length of the county. This section yields up to 2,000 gallons per minute (130 lites per second) of water to large wells and offers an excellent potential for the development of future groundwater supplies. Sea-water intrusion into the shallow aquifer is a potential threat to several coastal well fields. The wells nearest the coast were found to be most vulerable. GRA

N77-10630# Inter-American Tropical Tuna Commission, La Jolla, Calif.

COMPUTER PROCESSING OF LANDSAT-1 MSS DIGITAL IMAGERY FOR MARINE STUDIES

Robert G. Kirkham, Merritt R. Stevenson, and Forrest R. Miller Feb. 1976 77 p refs

(Grant NOAA-04-6-158-44043)

(PB-254655/4; NOAA-76042901) Avail: NTIS HC A05/MF A01 CSCL 08J

A procedure in which a series of 15 computer programs was developed to process data from the 4 spectral bands of multispectral scanner systems aboard LANDSAT-1 for the central part of the Gulf of California are described. Methods to specifically produce digital auxiliary tapes of full scenes from the EROS Computer Compatible Tapes (CCT's) and from these tapes to construct digital images using a high speed line printer are discussed. Comparison of prominent surface features in the gulf with computer generated benchmarks showed the gridding program to be quite accurate in generating geographical benchmarks for the full scene imagery. GRA

N77-10631# Pattern Analysis and Recognition Corp., Rome, N.Y.

SPECTRAL ANALYSIS Final Technical Report, Jun. 1973 - Jan. 1975

Alex Zanon, Michael Gillotte, and Michael Zoracki Griffiss AFB, N. Y. RADC Mar. 1976 299 p refs

(Contract F30602-73-C-0383)

(AD-A024209; PAR-75-9; RADC-TR-75-302) Avail: NTIS HC A13/MF A01 CSCL 08/7

This report investigates the application of digital image processing techniques to a selected set of multispectral images. Various processes for performing automatic classification on selected terrain classes on 9-lens multispectral imagery were tested. GRA

N77-10632# General Electric Co., Santa Barbara, Calif.

MONITORING GROUNDWATER QUALITY: DATA MANAGEMENT

Norman F. Hampton Apr. 1976 72 p refs

(Contract EPA-68-01-0759)

(PB-255492/1; GE75TMP-70; EPA-600/4-76-019) Avail: NTIS HC A04/MF A01 CSCL 08H

Management of a data base which assures that pertinent information is available when and where it is needed is discussed. The requirements of groundwater data management are described, and available capabilities which may serve to satisfy these requirements are examined. The means by which these capabilities can be used to accomplish the management of groundwater data are identified. GRA

N77-10633# Lewin and Associates, Inc., Washington, D.C.

THE POTENTIAL AND ECONOMICS OF ENHANCED OIL RECOVERY Final Report

Apr. 1976 274 p refs

(Contract FEA-CO-03-50222-000)

(PB-254991/3; FEA/B-76/221) Avail: NTIS HC A12/MF A01 CSCL 21D

The amount of oil that can be made available through enhanced recovery methods and the time and cost involved in its production are discussed. Potential oil reserves in California, Louisiana, and Texas are emphasized. GRA

N77-10634# Seattle Office of Management and Budget, Wash. Solid Waste/Methanol/Ammonia Project.

SOLID WASTE TO METHANOL/AMMONIA CONVERSION PLANT Final Environmental Impact Statement

Oct. 1975 290 p refs

(PB-255450/9; SWAP-75-1) Avail: NTIS HC A13/MF A01 CSCL 13B

It is proposed to construct a plant to process solid waste that will eliminate total dependence by the City of Seattle landfills as the means for disposal. The facility will use recently developed processes to extract useful material from the waste. The new process will reduce land requirements for solid waste disposal and generate useful chemicals that are now produced exclusively from natural gas. This document is an environmental impact statement for the proposed project which was selected from among 15 alternatives previously examined by the City. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N77-10635* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PHOTOVOLTAIC CELL ARRAY Patent

Jon T. Eliason, inventor (to NASA) (Sperry Rand Corp., Huntsville, Ala.) Issued 5 Oct. 1976 4 p Filed 25 Apr. 1975 Supersedes N75-22900 (13 - 14, p 1677) Sponsored by NASA

(NASA-Case-MFS-22458-1; US-Patent-3,984,256; US-Patent-Appl-SN-571458; US-Patent-Class-136-89; US-Patent-Class-29-572) Avail: US Patent Office CSCL 10A

A photovoltaic cell array consisting of parallel columns of silicon filaments is described. Each fiber is doped to produce an inner region of one polarity type and an outer region of an opposite polarity type to thereby form a continuous radial semi conductor junction. Spaced rows of electrical contacts alternately connect to the inner and outer regions to provide a plurality of electrical outputs which may be combined in parallel or in series. Official Gazette of the U.S. Patent Office

N77-10636* National Aeronautics and Space Administration. Pasadena Office, Calif.

HYDROGEN-RICH GAS GENERATOR Patent

John Houseman (JPL) and Donald J. Cerini, inventors (to NASA) (JPL) Issued 28 Sep. 1976 15 p Filed 10 Jul. 1974 Supersedes N76-18460 (14 - 09, p 1127) Sponsored by NASA

(NASA-Case-NPO-13560-1; NASA-Case-NPO-13561-1; US-Patent-3,982,910; US-Patent-Appl-SN-487156; US-Patent-Class-48-61; US-Patent-Class-23-281; US-Patent-Class-48-116; US-Patent-Class-48-117; US-Patent-Class-48-197R; US-Patent-Class-48-212; US-Patent-Class-123-3; US-Patent-Class-252-373; US-Patent-Class-423-650; US-Patent-Class-431-11; US-Patent-Class-431-41; US-Patent-Class-431-116; US-Patent-Class-431-162; US-Patent-Class-431-170) Avail: US Patent Office CSCL 10B

A process and apparatus are described for producing hydrogen-rich product gases. A spray of liquid hydrocarbon is mixed with a stream of air in a startup procedure and the mixture

is ignited for partial oxidation. The stream of air is then heated by the resulting combustion to reach a temperature such that a signal is produced. The signal triggers a two way valve which directs liquid hydrocarbon from a spraying mechanism to a vaporizing mechanism with which a vaporized hydrocarbon is formed. The vaporized hydrocarbon is subsequently mixed with the heated air in the combustion chamber where partial oxidation takes place and hydrogen-rich product gases are produced.
Official Gazette of the U.S. Patent Office

N77-10637*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LSSA (LOW-COST SILICON SOLAR ARRAY) PROJECT Quarterly Project Report, Apr. - Jun. 1976
8 Oct. 1976 172 p Sponsored in part by ERDA
(Contract NAS7-100)
(NASA-CR-149091; JPL-5101-7; ERDA/JPL-1012-76/6; QPR-1) Avail: NTIS HC A08/MF A01 CSCL 10A

Methods are explored for economically generating electrical power to meet future requirements. The Low-Cost Silicon Solar Array Project (LSSA) was established to reduce the price of solar arrays by improving manufacturing technology, adapting mass production techniques, and promoting user acceptance. The new manufacturing technology includes the consideration of new silicon refinement processes, silicon sheet growth techniques, encapsulants, and automated assembly production being developed under contract by industries and universities. Author

N77-10638*# Honeywell, Inc., Minneapolis, Minn. Energy Resources Center.
DESIGN, FABRICATION, TESTING, AND DELIVERY OF A SOLAR ENERGY COLLECTOR SYSTEM FOR RESIDENTIAL HEATING AND COOLING
T. H. Holland and J. T. Borzoni Oct. 1976 148 p refs
(Contract NAS8-31327)
(NASA-CR-150032) Avail: NTIS HC A07/MF A01 CSCL 10A

A low cost flat plate solar energy collector was designed for the heating and cooling of residential buildings. The system meets specified performance requirements, at the desired system operating levels, for a useful life of 15 to 20 years, at minimum cost and uses state-of-the-art materials and technology. The rationale for the design method was based on identifying possible material candidates for various collector components and then selecting the components which best meet the solar collector design requirements. The criteria used to eliminate certain materials were: performance and durability test results, cost analysis, and prior solar collector fabrication experience. Author

N77-10639*# Yardney Electric Corp., Pawcatuck, Conn. Electric Div.
EVALUATION OF INORGANIC/ORGANIC SEPARATORS Final Report
C. Philip Donnel, III Oct. 1976 20 p
(Contract NAS3-18530)
(NASA-CR-135108) Avail: NTIS HC A02/MF A01 CSCL 10C

Thirty-six (36) experimental 40AH sealed silver-zinc cells were constructed during phase I of this two (2) phase program. These cells were divided into six (6) groups of six (6) cells each. Each group of six (6) cells was evenly divided into two batches of three (3) cells each. Groups 1 through 4 each featured a different inorganic filler material in the slurry used to coat the separator substrate. Groups 5 and 6 featured an alternate method of separator bag construction. With the exception of the various separator materials, the parts and processes used to produce these thirty-six (36) cells were the same as those used to make the HR40-7 cell. The two (2) batches of cells in each cell group differed only in the lots of solutions and other separator slurry components used. Each cell was given two formation charge/discharge cycles prior to being shipped to NASA Lewis Research Center. Phase II of the program consisted of constructing another thirty-six (36) 40AH experimental cells in six (6) groups of six (6) cells each. Each group was distinguished by the type of precoated separator material used to fabricate separator bags. A new method of separator bag construction was used in this phase of the program. These cells were given two (2) formation cycles and shipped to NASA Lewis Research Center. Author

N77-10640*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EARLY OPERATION EXPERIENCE ON THE ERDA/NASA 100 kW WIND TURBINE
John C. Glasgow and Bradford S. Linscott Sep. 1976 25 p refs
(NASA-TM-X-71601; E-8076) Avail: NTIS HC A02/MF A01 CSCL 10A

As part of the Energy Research and Development Administration (ERDA) wind energy program, NASA Lewis Research Center is testing an experimental 100-kW wind turbine. Rotor blade and drive shaft loads and tower deflection were measured during operation of the wind turbine at rated rpm. The blade loads measured are higher than anticipated. Preliminary results indicate that air flow blockage by the tower structure probably caused the high rotor blade bending moments. Author

N77-10641*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SERIES-PARALLEL METHOD OF DIRECT SOLAR ARRAY REGULATION
S. T. Gooder Sep. 1976 16 p refs
(NASA-TM-X-73505; E-8906) Avail: NTIS HC A02/MF A01 CSCL 10A

A 40 watt experimental solar array was directly regulated by shorting out appropriate combinations of series and parallel segments of a solar array. Regulation switches were employed to control the array at various set-point voltages between 25 and 40 volts. Regulation to within + or - 0.5 volt was obtained over a range of solar array temperatures and illumination levels as an active load was varied from open circuit to maximum available power. A fourfold reduction in regulation switch power dissipation was achieved with series-parallel regulation as compared to the usual series-only switching for direct solar array regulation. Author

N77-10642*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A SUMMARY OF THE ECAS MHD POWER PLANT RESULTS
George R. Seikel and L. P. Harris (GE Co., Schenectady, N. Y.) 1976 24 p refs Presented at the 3d US-USSR Colloq. on Magnetohydrodyn., Moscow, 21-22 Oct. 1976
(NASA-TM-X-73491; E-8884) Avail: NTIS HC A02/MF A01 CSCL 10B

The performance and the cost of electricity (COE) for MHD systems utilizing coal or coal derived fuels are summarized along with a conceptual open cycle MHD plant design. The results show that open cycle coal fired recuperatively preheated MHD systems have potentially one of the highest coal-pile-to-bus bar efficiencies (48.3%) and also one of the lowest COE of the systems studied. Closed cycle, inert gas systems do not appear to have the potential of exceeding the efficiency of or competing with the COE of advanced steam plants. Author

N77-10643# Oak Ridge National Lab., Tenn. Energy Div.
TRANSPORTATION ENERGY CONSERVATION DATA BOOK
A. S. Loebl, D. J. Bjornstad, D. F. Burch, E. B. Howard, J. F. Hull, D. G. Madewell, N. S. Malthouse, and M. C. Ogle Oct. 1976 279 p refs
(Contract W-7405-eng-26)
(ORNL-5198) Avail: NTIS HC A13/MF A01

Statistical data on energy use in the transportation sector are presented in the form of tables, graphs, and charts. The following topics are covered in six chapters: characteristics of transportation modes; energy characteristics, including energy consumption by source and by sector and energy intensiveness; conservation alternatives; government impacts, including expenditures, regulations and research, development, and demonstration spending; energy supply, including domestic petroleum production, prices, and projections; and transportation demand, including population characteristics and economic determinants. A bibliography of data sources is provided at the end of each chapter, and a more general bibliography is included at the end of the book. Author

N77-10644# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

UTILIZATION OF GEOTHERMAL ENERGY

I. I. Glass Aug. 1976 74 p refs Sponsored in part by the Sci. Council of Can.

(UTIAS-Review-40; CN-ISSN-0082-5247) Avail: NTIS HC A04/MF A02

Like the sun, the earth is a vast energy source. The utilization of this geothermal furnace is still in its infancy. The heat flow from the mantle to the surface is the energy equivalent to 2 x 10 to the 11th power barrels of oil per year. Although today only local hot spots yielding dry and wet steam, and shallow hot water sites are used economically, future technology may well lead to a much greater utilization through additional imaginative and sophisticated exploitation of available regions of dry hot rock, and deep areas of significant heat flow. Author

N77-10645*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SOLAR CELL SHINGLE Patent Application

Americo F. Forestieri, Anthony F. Ratajczak, and Leroy G. Sidorak, inventors (to NASA) Filed 24 Aug. 1976 11 p

(NASA-Case-LEW-12587-1; US-Patent-Appl-SN-717319) Avail: NTIS HC A02/MF A01 CSCL 10A

A solar cell shingle may be made of an array of solar cells on a lower portion of a substantially rectangular shingle substrate made of fiberglass cloth or the like. The solar cells may be encapsulated in fluorinated ethylene propylene or some other weatherproof translucent or transparent encapsulant to form a combined electrical module and a roof shingle. The interconnected solar cells are connected to connectors at the edge of the substrate through a connection to a common electrical bus or busses. An overlap area is arranged to receive the overlap of a cooperating similar shingle so that the cell portion of the cooperating shingle may overlie the overlap area of the roof shingle. Accordingly the same shingle serves the double function of an ordinary roof shingle which may be applied in the usual way and an array of cooperating solar cells from which electrical energy may be collected. NASA

N77-10646# Energy Research and Development Administration, Washington, D.C.

CREATING ENERGY CHOICES FOR THE FUTURE. PUBLIC MEETING ON A NATIONAL PLAN FOR ENERGY RESEARCH, DEVELOPMENT, AND DEMONSTRATION

1975 227 p Conf. held in Seattle, 2 Dec. 1975

(CONF-751228-P2) Avail: NTIS HC A11/MF A01

Papers are presented dealing with a national plan for energy research and development. State, University, and private sectors are represented. J.M.S.

N77-10647# ACE-Federal Reporters, Inc., Washington, D.C.

CREATING ENERGY CHOICES FOR THE FUTURE

1975 382 p Proceedings of Public Meeting on a Natl. Plan for Energy Res., Develop., and Demonstration, Seattle, 2 Dec. 1975

(CONF-751228-P1) Avail: NTIS

A public meeting was held and its purpose was to permit an exchange of information between the people of the Pacific Northwest and the Federal government, specifically the Energy Research and Development Administration, to provide information to the public and to receive input from the public about that agency's national energy research, development, and demonstration plan in creating energy sources for the future. In addition to presentations by seven preliminary speakers, presentations of 26 other speakers representing Federal and state governments, universities and the private sector, as well as the panel discussions, are included. ERA

N77-10648# Brookhaven National Lab., Upton, N.Y.

PROSPECTS FOR HYDROGEN PRODUCTION BY WATER ELECTROLYSIS TO BE COMPETITIVE WITH CONVENTIONAL METHODS

S. Srinivasan and F. J. Salzano 1976 16 p refs Presented at the 1st World Hydrogen Energy Conf., Miami Beach, Fla., 1 Mar. 1976 Sponsored by ERDA

(BNL-20877; Conf-760304-10) Avail: NTIS HC A02/MF A01

With the impending unavailability of oil and natural gas, hydrogen will be produced on a large scale in the United States (1) from coal, or (2) by water electrolysis using electricity derived from nuclear or solar energy. In many parts of the world which lack fossil fuels, the latter will be the only possible method. The cost of purification of hydrogen produced from fossil fuels will increase its cost to about the same level as that of electrolytic hydrogen. When hydrogen is required in relatively small quantities too, the electrolytic method is advantageous. To minimize the cost of hydrogen produced by water electrolysis, it is necessary to reduce capital costs and approach 100 percent energy efficiencies. The General Electric Solid Polymer Water Electrolyzer and Teledyne Alkaline Water Electrolysis Cells, both operating at about 120-150 C, look most promising in achieving the goals of low capital cost and high energy efficiency. Author (ERA)

N77-10649# Brookhaven National Lab., Upton, N.Y.

WATER ELECTROLYSIS VS THERMOCHEMICAL PRODUCTION OF HYDROGEN: A PARAMETRIC ASSESSMENT

F. J. Salzano and C. Braun 1976 22 p Presented at the 1st World Hydrogen Energy Conf., Miami Beach, Fla., 1 Mar. 1976 Sponsored by ERDA

(BNL-20878, Conf-760304-7) Avail: NTIS HC A02/MF A01

A general discussion of hydrogen production by electrolytic and thermochemical processes is presented. A hydrogen production cost computation and cost sensitivity data for the various production methods are reported. ERA

N77-10650# Los Alamos Scientific Lab., N.Mex.

GEOTHERMAL ENERGY FOR POWER GENERATION

Jefferson W. Tester 1976 8 p refs Presented at the IEEE Region Six Conf., Tucson, Ariz., 7-9 Apr. 1976

(Contract W-7405-eng-36)

(LA-UR-76-369; Conf-760416-1) Avail: NTIS HC A02/MF A01

The magnitude of the geothermal resource base for natural hydrothermal systems and for artificially stimulated dry hot rock systems is evaluated for the United States with respect to necessary technology required for development. The utilization of geothermal fluids ranging in temperature from 100 to 300 deg C is discussed from a thermodynamic and economic viewpoint. Direct steam flashing and a number of binary-fluid Rankine cycle arrangements employing nonaqueous working fluids are compared as to the performance of their power conversion cycle. In addition, the status of component development for advanced geothermal conversion systems is discussed. A generalized cost model is developed for predicting electric generating costs as a function of characteristics of the resource, including geothermal temperature gradient, reservoir capacity, and fluid temperature. ERA

N77-10651# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.

SOLAR POWER ARRAYS FOR THE CONCENTRATION OF ENERGY

V. D. Albertson Nov. 1975 19 p refs

(Contract E(11-1)-2699)

(COO-2699-2) Avail: NTIS HC A02/MF A01

A model is developed which yields the solar flux density distribution on the surface of a vertical cylindrical receiver mounted on a tower centrally located in a horizontal circular ring-shaped mirror field. The flux density at a given location on the receiver surface is shown to be given by the numerical integration of a simple analytical expression. Strategies are examined for redistributing the solar flux input to obtain a desired distribution or maintain a specified distribution throughout the day. The solar flux density distribution is expressed as a dimensionless concentration ratio which can be derived from universal curves and then used in the design of receivers to meet specified flux levels. Author (ERA)

N77-10652# California Univ., Livermore. Lawrence Livermore Lab.

WILL THE LARGE-SCALE PRODUCTION OF HYDROGEN BE PART OF THE ENERGY PROBLEM OR PART OF ITS SOLUTION

G. D. Sauter 31 Dec. 1975 18 p refs Presented at the First World Hydrogen Energy Conf., Miami Beach Fla., 1-3 Mar. 1976

(Contract W-7405-eng-48)
(UCRL-76844; Conf-760304-11) Avail: NTIS HC A02/MF A01

The energy dynamics of nuclear reactors as a means of generating hydrogen were analyzed. Attention was focused on the following questions, over a range of values for the rate of expansion of the reactor network and the ratio of the energy required to build a reactor to the energy it produces: (1) the energy cost of developing a given system whether it would produce more energy than it costs or be a net drain on our already troubled energy economy, and (2) given that the system will produce net energy, whether the energy would be produced in adequate amounts and in a timely fashion. Based on the results of this analysis, a specific scenario was examined - the development by the year 2000 of the capacity to generate annually the amount of hydrogen which has the heat content of the natural consumed in the U.S. in 1970. For this scenario, it appears that the reactors, rather than the hydrogen, will be the energy storage mechanism. ERA

N77-10653# Westinghouse Electric Corp., Lester, Pa. Heat Transfer Div.

ADVANCED COAL GASIFICATION SYSTEM FOR ELECTRIC POWER GENERATION Quarterly Progress Report, 1976

R. M. Chamberlain, D. L. Keairns, B. W. Lancaster, L. A. Salvador, E. F. Sverdrup, E. J. Vidt, and P. W. Pillsbury 15 Oct. 1975 172 p refs
(Contract E(49-18)-1514)
(FE-1514-176) Avail: NTIS HC A08/MF A01

Analytical tasks and experiments necessary to evolve a coal gasification system for electric power generation are reported. Development unit's devolatilizer/desulfurizer underwent cold flow dynamics tests and is now ready to begin hot operation on coal. Test facilities for developing low Btu gas burning combustors to be fitted to large utility-type gas turbines are now in operation. Feasibility of constructing combustors to fit the space envelope of utility gas turbines was established; refinement of the designs to better deal with startup, turndown, dual fuel operation and emissions control is under way. Maximum economic potential of this process will be realized by cleaning the product gas of particulates and trace contaminants at 1600 F before burning in a gas turbine. Efforts both to define the required cleanliness and to assure removal of particulates down to present fuel gas standards are as yet inconclusive. A conceptual design for a gasification plant embodying fluid bed principles and sized to process coal for the largest commercially available utility gas turbine was developed. Author (ERA)

N77-10654# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.

GENERAL ANALYTICAL PROCEDURE FOR MEASURING CHROMIUM (VI) AND TOTAL CHROMIUM IN REACTED THERMAL BATTERY CELLS

B. M. Dillard 22 Mar. 1976 13 p refs
(Contract E(29-2)-656)
(GEPP-212) Avail: NTIS HC A02/MF A01

To evaluate the methods for determining Cr(VI) and total chromium in a reacted single cell thermal battery, tests first involved the removal of reaction products from the anode with acetic acid. The Cr(VI) reaction products are soluble in acetic acid whereas iron products are very slightly soluble. The presence of Cr(VI) was determined iodometrically. A chromium compound insoluble in acetic acid was identified as $Li_2O.Cr_2O_3$ by X-ray diffraction. Other insoluble products were compounds of iron and amorphous materials. This insoluble material was fused with sodium carbonate and extracted with hydrochloric acid. The chromium compound was dissolved in this manner. Atomic absorption spectroscopy was used to determine total chromium in both acetic acid and hydrochloric acid solutions. Precise sample weights and percent calcium chromate were not known for samples used in this study. Author (ERA)

N77-10655# Sandia Labs., Albuquerque, N.Mex.

SURVEY OF HIGH TEMPERATURE THERMAL ENERGY STORAGE

T. T. Bramlette, R. M. Green, J. J. Bartel, D. K. Ottesen, C. T. Schafer, and T. D. Brumleve Mar. 1976 181 p refs
(Contract AT(29-1)-789)
(SAND-75-8063) Avail: NTIS HC A09/MF A01

The generic classes of storage concepts considered are sensible heat, latent heat, and heat of reversible chemical reaction. The study includes (1) a review of the basic thermodynamic aspects of thermal energy storage; (2) a summary of storage concepts which were conceptualized and/or built and tested, including comparisons of system characteristics within the generic classes; and (3) specific technology surveys within the areas of materials problems, heat transfer and fluid mechanics problems and systems application. It is shown that the design and engineering of thermal storage systems have not progressed beyond the most simple concepts. Current technology appears adequate to support the development of most sensible heat concepts and simple latent heat concepts. ERA

N77-10656# Oak Ridge National Lab., Tenn.

WASTE HEAT VS CONVENTIONAL SYSTEMS FOR GREENHOUSE ENVIRONMENTAL CONTROL: AN ECONOMIC ASSESSMENT

M. Olszewski, S. J. Hilenbrand, and S. A. Reed Mar. 1976 39 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5069) Avail: NTIS HC A03/MF A01

Because of rising fuel costs greenhouse operators are seeking alternate methods and fuels to heat their greenhouses. A hypothetical greenhouse operation using power plant reject heat for winter heating was investigated on a cost basis. The greenhouse temperature control system, which is used for both heating and cooling, operates by flowing water down an evaporative pad while air is drawn across the pad. This direct contact energy exchange provided cooling in the summer, by water evaporation, while heating in the winter is provided by sensible heat transfer. The warm water for winter heating is supplied by the reject heat from a power plant. A comparison of the total cost for the bimodal system and a traditional greenhouse system indicates that the bimodal system is economically competitive if the pad water inlet temperature is maintained above 80 F. An analysis of typical greenhouse fixed and operating costs and revenue shows that the use of fossil fuels (coal or natural gas) results in an operating loss for all but mild climates. Author (ERA)

N77-10657# Maryland Univ., College Park. Dept. of Mechanical Engineering.

CCMS SOLAR ENERGY PILOT STUDY SOLAR HEATING AND COOLING SYSTEMS IN BUILDINGS

F. H. Morse, ed. and I. B. Rose, ed. Dec. 1975 153 p refs Presented at Ann. Meeting of the CCMS Solar Energy Pilot Study, Palo Alto, Calif., 4-6 Aug. 1975
(Contract AT(40-1)-4908)
(UMD-4908-5; Conf-750879) Avail: NTIS HC A08/M A01

The objectives of the 1975 CCMS Solar Energy Pilot Study Meeting were: (1) to review the activities of the CCMS Pilot Study since the Odeillo meeting and to discuss the activities planned for the coming year, (2) to provide the participants with an up-to-date description of the status of the solar heating and cooling systems programs of the participating countries; (3) to discuss and approve the recommendations of the format committee; (4) to provide the participants with status reports on those projects for which special format reports will be prepared during the coming year; and (5) to hear the report of The Zero Energy House Project Group and to discuss the formation of additional project groups. Countries represented at the meeting included Australia, the Bahamas, Belgium, Brazil, Canada, Denmark, El Salvador, FR of Germany, France, Greece, Israel, Italy, Jamaica, Netherlands, New Zealand, Philippines, Portugal, Saudi Arabia, Spain, Sweden, UK, UNESCO, and USA. ERA

N77-10658# Dravo Corp., Pittsburgh, Pa. Chemical Plants Div.

HANDBOOK OF GASIFIERS AND GAS TREATMENT SYSTEMS Final Report

Feb. 1976 171 p refs
(Contract E(49-18)-1772)
(FE-1772-11) Avail: NTIS HC A08/MF A01

The intent of this handbook is to provide a ready reference on gasifiers and gas treatment systems that are or may be

applicable to coal conversion technology. The handbook contains sections on 22 gasifiers and 20 gas-treatment systems, including those presently available in the commercial market as well as those currently under development. The handbook is comprised of objective information collected from various sources and includes data, such as: the state of development, a description of the process, capacity, products, by-products, utilities and environmental considerations. The handbook is not intended as a comparative evaluation, but rather as an impartial reference on the current technology. ERA

N77-10659# Addis Translations International, Portola Valley, Calif.
UNDERGROUND FUEL GASIFICATION
A. Kroms Dec. 1975 9 p refs Transl. into ENGLISH from Technikas Apskats (Lincoln, Neb.), v. 35, 1962 p 16-17 Prepared for Lawrence Livermore Lab., Livermore, Calif. Sponsored by ERDA
(UCRL-Trans-10998) Avail: NTIS HC A02/MF A01

Gasification of coal facilitates supply and distribution logistics, improves the quality of the energy vehicle (especially with low quality coal) and permits more efficient conversion to heat at the consumption end. Underground gasification would minimize much difficult and dangerous work, and may be the only way to use narrow or lower grade strata. If the coal is gasified with air, the gas obtained has a low heating value and is not suitable for long distance transport; if oxygen or steam is used, the product is a high grade water gas. Underground gasification methods and experience in several countries are outlined briefly. The results were not too favorable. ERA

N77-10660# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (West Germany). Inst. fuer Chemische Raketenantriebe.
STORAGE OF ECOGENIC PRIMARY ENERGIES [SPEICHERUNG OEKOGENER PRIMAERENERGIEN]
J. Nitsch 7 Jul. 1975 21 p In GERMAN Presented at the Meeting on Nicht fossile, nicht nukl. Primaerenergietraeger, Juelich, West Ger., 27 Jun. 1975
(DLR-IB-456-75/7) Avail: NTIS HC A02/MF A01

Aspects of storing ecogenic primary energy, i.e. energy from the sun, wind, water, earth, and sea are discussed, notably thermal, mechanical, chemical, and electrochemical storage. Topics dealt with include heat capacity, energy capacity of eutectic fluoride mixtures, influence of storage surface on subsequently added heat, chemical storage possibilities (hydrogen, latent energy gas mixtures, synthetic gases, synthetic hydrocarbons), thermochemical and electrolytic hydrogen production, biochemical hydrogen production, and energy densities of storage media. ESA

N77-10661# Compagnia Generale di Elettricita S.p.A., Milan (Italy). Div. Elettronica.
TESTING OF NiCd CELLS OVER GEOSTATIONARY ORBIT TYPE CYCLING PERIOD
[1975] 65 p
(Contract ESTEC-1185/70-HP)
(ESA-CR(P)-832) Avail: NTIS HC A04/MF A01

Geostationary orbit type cycling was carried out in order to permit NiCd cell lifetime to be assessed as a function of temperature, charge rate and factor, and depth of discharge in unlimited charge mode operation. A second objective was to collect information on correlation between cell operation in geostationary orbit type cycling and operation under fixed depth of discharge cycling conditions. Tests performed on 180 NiCd cells are described and data collected during 2 years' cycling are presented. Author (ESA)

N77-10662# California Univ., Berkeley. Lawrence Berkeley Lab.
A LINEAR ECONOMIC MODEL OF FUEL AND ENERGY USE IN THE UNITED STATES. VOLUME 1: MODEL DESCRIPTION AND RESULTS Final Report
C. Roger Glassey and Peter Benenson Dec. 1975 180 p refs
(PB-252485/8; EPRI-ES-115-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 10A

A linear programming model of the U.S. economy in 1972 with emphasis on energy and fuel use was constructed, based on the 1967 national input-output table updated to 1972. The results describe the direct and indirect economic impacts of each shortage simulated. Changes in gross national product, total employment, employment by industry and occupation, fuel substitution in the electric utilities and iron and steel sectors, imports, and output by sector are among the results calculated by the model. Published final demand and industrial capacity projections for 1975, 1980, and 1985 were combined with the 1972 model to permit investigation of the impacts of energy shortages in these years. GRA

N77-10663# California Univ., Berkeley. Lawrence Berkeley Lab.
A LINEAR ECONOMIC MODEL OF FUEL AND ENERGY IN THE UNITED STATES. VOLUME 2: SUBMODELS AND DATA Final Report
C. Roger Glassey and Peter Benenson Dec. 1975 138 p refs
(PB-252486/6; EPRI-ES-115-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 10A

A model is developed for investigating the pattern of energy use in the United States and to examine the economic impacts of fuel and energy shortages. The submodel description and data are presented. GRA

N77-10664# Tetra Tech, Inc., Arlington, Va.
ENERGY FACT BOOK 1975. PARTS 1-5: APPENDIXES A-H
Glen Tomlinson 30 Jun. 1975 198 p refs
(Contract N00014-74-C-0348)
(AD-A023010; TETRAT-A-642-75-169-Pt-1-5) Avail: NTIS HC A09/MF A01 CSCL 10/1

Contents: Present energy situation; Energy R and D in other countries; Energy R and D legislation during the 93rd and 94th congresses; Federal government energy research and development. GRA

N77-10665# Battelle Columbus Labs., Ohio.
ENERGY: THE POLICY PLANNING FRAMEWORK IN STATE GOVERNMENTS. VOLUME 1: SUMMARY REPORT
Jules J. Duga, David W. Malone, and Richard M. Davis 1976 48 p refs
(Grant NSF SIA-75-18811)
(PB-254466/6; NSF/RA-760120-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 04A

A summary of the evaluation methodology developed and a brief description of the status of energy policy planning across the country, particularly in the five states funded through the NSF/RANN programs are presented. The methodology was developed for the purpose of providing a framework within which programs could be evaluated. GRA

N77-10666# Battelle Columbus Labs., Ohio.
ENERGY: THE POLICY PLANNING FRAMEWORK IN STATE GOVERNMENTS. VOLUME 2: APPENDICES
Jules J. Duga, David W. Malone, and Richard M. Davis 1976 90 p refs
(Grant NSF SIA-75-18811)
(PB-254467/4; NSF/RA-760121-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 05A

For abstract, see N77-10665.

N77-10667# Acres American, Inc., Buffalo, N. Y.
UNDERGROUND PUMPED STORAGE RESEARCH PRIORITIES
David C. Willett Apr. 1976 132 p refs
(PB-254413/8; EPRI-AF-182) Avail: NTIS HC A07/MF A01 CSCL 10A

The current status of underground pumped storage is examined to identify specific elements requiring developmental work to encourage the adoption of the concept by electric power utilities. Aspects reviewed include siting and site investigation, provision of access to the underground facilities, the excavation of the lower reservoir cavern, and the availability of the requisite rotating equipment. Primary areas recommended for developmental work include the adaption of mining technology to the lower cavern excavation, the development of hoist equipment capable of handling loads to 120 tons, and the extension of single-stage

reversible pump turbine capability to the 2,460 foot (750-meter) to 3,280 foot (1,000-meter) head range. GRA

N77-10668# Massachusetts Univ., Amherst. Energy Alternatives Program.
AN INVESTIGATION OF HEAT EXCHANGERS FOR OCEAN THERMAL ENERGY CONVERSION (OTEC) SYSTEMS
Richard Braren and Jon G. McGowan Sep. 1975 140 p refs
(Grant NSF GI-34979)
(PB-252640/8; NSF/RANN/SE/GI-34979/TR/75/8;
NSF/RA/N-75-236) Avail: NTIS HC A07/MF A01 CSCL 10A

Analytical results for the design of evaporators and condensers for ocean thermal energy conversion (OTEC) systems are presented. The generalized digital computer program for OTEC thermal cycle analysis was used for several parametric studies. These included the investigation of: (1) power plant size, (2) heat exchanger materials, (3) plastic plate-fin exchangers, (4) siting choice, (5) tube bank evaporators, (6) fouling effects, and (7) evaporator recirculation. Models are developed for evaluation of the steady-state off-design performance of both the evaporator and condenser, and an initial off-design study is made of a particular system design. GRA

N77-10669# ICF, Inc., Washington, D.C.
SUMMARY OF EPA ENERGY POLICY ANALYSIS
William C. Stitt and Donald G. Ogilvie 1975 128 p refs
(Contract EPA-68-01-0590)
(PB-253361/0) Avail: NTIS HC A07/MF A01 CSCL 10A

Topic areas discussed include: The nature of the energy--environmental problem; U.S. energy consumption and supply outlook; key energy proposals; and Macro-environmental implications of energy growth. GRA

N77-10670# ICF, Inc., Washington, D.C.
GASOLINE AND DISTILLATE SHORTAGE SITUATION: 1972-1976
1976 151 p
(Contract EPA-68-01-0590)
(PB-253322/2) Avail: NTIS HC A07/MF A01 CSCL 21D

A partial listing of contents includes: dynamics of the tight gasoline and distillate supply situation; effects of government policy on fuel shortages; outlook for gasoline and distillate demand and supply; estimating problems and policymaking implications; short and moderate term demand-supply estimates; government policy options; elements of an approach to solving oil supply problems; specific oil policy options. GRA

N77-10671# Rockwell International Corp., Canoga Park, Calif. Atomics International Div.
DEVELOPMENT OF LITHIUM-METAL SULFIDE BATTERIES FOR LOAD LEVELING Progress Report
S. Sudar, L. A. Heredy, G. Ervin, J. C. Hall, and S. C. Lai May 1976 85 p refs
(PB-253164/8; EPRI-EM-166) Avail: NTIS HC A05/MF A01 CSCL 10C

The principal activities of the lithium-iron sulfide battery program include negative and positive electrode development, preparation and testing of lithium-resistant ceramic components, and cell design, construction and operation. Positive electrode research and operation of a 100-whr cell were conducted; a 150-whr sealed cell employing four electrode pairs, each with a surface area of 110 sq. cm, was designed, built, and placed in operation, and negative electrode research was performed. GRA

N77-10672# Delaware Univ., Newark. Inst. of Energy Conversion.
THEORETICAL PROSPECTS OF THE CdS-Cu2S SOLAR CELL
A. Rothwarf Mar. 1976 16 p refs Presented at the Intern. Conf. on Solar Elec., Toulouse, 1-5 Mar. 1976
(Grants NSF AER-72-03478-A04; NSF GI-34782)
(PB-252409/8; NSF/RANN/AER-72-03478-A04/TR76;
NSF/RA-760059) Avail: NTIS HC A02/MF A01 CSCL 10B

The role of interface states in determining the properties of the cells is demonstrated. The effects of crystallite size are included. Ways of increasing the efficiency of the cells are indicated. GRA

N77-10673# Little (Arthur D.), Inc., Cambridge, Mass.
A LOCATION MATRIX PLAN FOR THE RESIDENTIAL SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM. VOLUME 1: FINDINGS AND RECOMMENDATIONS
May 1976 41 p
(Contract H-2350)
(PB-253784/3; ADL-C-78534-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 13A

A detailed plan for the experimental portion of the residential solar heating and cooling demonstration program to be conducted by HUD is given. The plan is designed to permit HUD, in a structured series of demonstration projects, to investigate the effect of building codes, zoning regulations, tax procedures, and other administrative activities on the practical use of solar energy for heating and cooling buildings and heating domestic water in various climate and geographic areas. The report recommends site locations for the site-systems projects, states the type of systems that are most compatible with the site locations that have been recommended, and presents a general schedule of events describing how the program is expected to evolve. GRA

N77-10674# Delaware Univ., Newark. Inst. of Energy Conversion.
DIRECT SOLAR ENERGY CONVERSION FOR LARGE SCALE TERRESTRIAL USE Final Report, 1 Jun. 1972 - 30 Jun. 1975
K. W. Boer 30 Jun. 1975 279 p refs
(Grant NSF AER-72-03478)
(PB-252539/2; NSF/RANN/AER-72-03478-A03/FR/7
NSF/RA/N-75-233) Avail: NTIS HC A13/MF A01 CSCL 10B

Significant progress was made on all major aspects of the CdS/Cu2S solar cell. Cell fabrication facilities and techniques were established. Substrate and CdS characteristics were studied; electron microscopy and diffraction were used to determine its topography and crystal structure. Energy dispersive X-ray diffraction, Rutherford backscattering, and Auger studies were made in the Cu(x)S and heterojunction regions. Copper diffusion in CdS, and the synthesis and high temperature phase behavior of Cu(x)S are discussed. Solar simulation facilities are established and described. Junction capacitance, uniformity of cell response, electron diffusion length and Cu(x)S sheet resistance measurements are described. GRA

N77-10675# General Electric Co., Philadelphia, Pa. Space Div.
TWO COMPONENT THERMAL ENERGY STORAGE MATERIAL Final Report
E. M. Mehalick and A. T. Tweedie Nov. 1975 45 p refs Sponsored in part by ERDA
(Grant NSF AER-74-09186)
(PB-252592/1; NSF/RANN/SE/AER-74-09186;
NSF/RA/N-75-231) Avail: NTIS HC A03/MF A01 CSCL 10C

A thermal energy storage medium consisting of a slurry of spherically shaped capsules of encapsulated paraffin in a water carrier combines the advantages of the heat capacity of a phase change material and the high heat transfer rate of a slurry. The feasibility of this concept was evaluated by subjecting samples of such slurries to simulated solar system environmental conditions which included thermal cycling, system temperature levels, and slurry flow agitation due to stirring and pumping. The results of the evaluation program showed that paraffin can be encapsulated with a wall durable enough to withstand the temperature, thermal cycling, and moderate agitation without damage. The slurry storage capacity was also shown to be a factor of two higher than a water system on a per unit volume basis, assuming a 20F temperature change and a 40% solids slurry. The potential exists for even higher storage capacities at higher solids concentration levels. GRA

N77-10676# Schlesinger (Robert J.), Tarzana, Calif.
HYBRID SIMULATION OF SOLAR HVAC SYSTEM FOR HOUSE RETRO-FIT DESIGN Final Report
Robert J. Schlesinger Sep. 1975 61 p refs Sponsored in part by ERDA
(Grant NSF GI-43896)

(PB-252608/5; ERDA/SE/GI-43896/PR/75/10; NSF/RA/N-75-224) Avail: NTIS HC A04/MF A01 CSCL 13A

A small analog solar HVAC simulator that can be used as a research tool as well as provide a possible approach to sizing solar systems for retro-fit installations in dwellings is discussed. The circuitry used in the simulator, as well as plots of the data obtained with the system are given. The simulator responds to the weather, the life style of the occupants, and the energy needs of the building. The data and plots provide performance results for several collector/storage combinations simulated. GRA

N77-10677# Maine Univ., Orono. Dept. of Electrical Engineering.

TERNARY COMPOUND THIN FILM SOLAR CELLS Quarterly Report, 1 Dec. 1975 - 29 Feb. 1976

L. L. Kazmerski Mar. 1976 39 p refs

(Grant NSF AER-75-19576)

(PB-253344/6; NSF/RANN/SE/AER75-19576/PR-75; NSF/RA-760071; QR-2) Avail: NTIS HC A03/MF A01 CSCL 10B

The photoconductivity effects in chalcopyrite thin films were examined. Photoconductivity spectra give an indication of the spectral response of the films. These data were used to experimentally determine the temperature dependence of the energy gaps for CuInS2, CuInSe2 and CuInTe2 films. Photoconductive response gives some indication of the photovoltaic sensitivity of the materials and a measure of the effective carrier lifetimes. The characteristics of several thin film devices are reported. The device parameters of CuInSe2/CdS heterojunctions are presented. The in-situ and etched junction methods of device fabrication are discussed. The initial diode characteristics are also presented for CuInS2 homojunction devices produced by in-situ and sulfurization. Several other devices are discussed. Finally, the techniques used to produce single phase CuInS2 source material are presented. GRA

N77-10678# American Cyanamid Co., Stamford, Conn. Chemical Research Div.

CADMIUM STANNATE SELECTIVE OPTICAL FILMS FOR SOLAR ENERGY APPLICATIONS Quarterly Progress Report, 1 Jan. - 31 Mar. 1976

G. Haacke and L. C. Burton (Delaware Univ., Newark) Apr. 1976 32 p refs

(Grant NSF AER-73-07957)

(PB-254879/0; NSF/RANN/SE/AER73-07957/PR-76; NSF/RA-760101; QPR-1) Avail: NTIS HC A03/MF A01 CSCL 10B

Spray-coating development was concentrated on improving the optical transmission of low sheet resistance cadmium stannate films. Conditions for the sputter deposition of (Cd2SnO4) onto glass were established to solve the adhesion problem encountered with Zn(x)Cd(1-x)S films. Cadmium stannate coated silicon wafers were found to be efficient selective solar heat absorbers. The CdS backwall solar cell development was extended to the Zn(x)Cd(1-x)S system. Open circuit voltages of 0.63 volts were achieved. GRA

N77-10679# Boeing Co., Seattle, Wash. Engineering and Construction Div.

CLOSED CYCLE, HIGH-TEMPERATURE CENTRAL RECEIVER CONCEPT FOR SOLAR ELECTRIC POWER Interim Report

J. R. Gintz Feb. 1976 140 p

(PB-254399/9; EPRI-ER-183) Avail: NTIS HC A07/MF A01 CSCL 10B

Feasibility was examined in terms of system life, efficiency, cost, and technology requirements. These considerations are implemented in the conceptual design of a preferred receiver and its components for utilization in a solar plant of 100 megawatt electrical power output. The rationale is provided which supports the configuration, equipment arrangement, and material choices. A thermal cycling test simulating a 30-year lifetime of the receiver heat exchanger at temperatures to 816 C (1500 F) and at 34 bar (500 psi) helium pressure, confirmed the material choice. A preliminary design of a model receiver, appropriately scaled to 1 megawatt of thermal energy into the receiver, is presented as a candidate for early test. GRA

N77-10680# RAND Corp., Santa Monica, Calif.

A SIMULATION ANALYSIS OF US ENERGY DEMAND, SUPPLY, AND PRICES

Kent P. Anderson Oct. 1975 106 p refs

(Grants NSF GI-44; NSF SIA-74-18660)

(PB-254314/8; R-1591-NSF/EPA; NSF/RA/N-75-301) Avail: NTIS HC A06/MF A01 CSCL 10A

This report describes the development of a simulation model of U.S. energy demand, supply and price, and comments on the results obtained in initial test runs. Details of the model are included for use by researchers familiar with common current specifications of supply and demand functions. The model includes the following user demand sectors and energy types: (1) residential (electricity, gas, oil); (2) commercial (electricity, gas, oil), (3) industrial (electricity, gas, distillate and residual oils), (4) transportation (petroleum products); and (5) residual (coal, electricity, gas, oil). The model contains the following supply activities: (1) coal; (2) petroleum; (3) gas; and (4) electricity. In addition several energy supply and demand projections are provided for analysts interested in the application of models to energy problems. GRA

N77-10681# American Univ., Washington, D.C.

RESEARCH ON ELECTROCHEMICAL ENERGY CONVERSION SYSTEMS Final Technical Report, Oct. 1971 - Jun. 1975

Alayne A. Adams and Robert T. Foley Dec. 1975 124 p refs

(Contract DAAK02-72-C-0084; DA Proj. 1T1-61102-A-34A)

(AD-A023689; FTR-7) Avail: NTIS HC A06/MF A01 CSCL 10/2

The research on electrochemical energy conversion system has involved work on two tasks: a search for electrolytes alternative to phosphoric acid for direct and indirect hydrocarbon-air fuel cells, and a study of the corrosion characteristics of electrolytes for intermediate-temperature hydrocarbon-air fuel cells. A tabulation of the characteristics of an ideal fuel cell electrolyte established that there were five classes of chemical compounds that could be the sources of new, improved electrolytes. One class, the fluorinated sulfonic acids, through one member of the class, trifluoromethanesulfonic acid monohydrate, was investigated in some depth. This compound, when used as an electrolyte in hydrocarbon-air half cells, exhibits exceptional properties in comparison to conventional electrolytes such as phosphoric acid. The electrooxidation of propane and hydrogen is increased by an order of magnitude. The limiting current for the electroreduction of oxygen is increased somewhat but the open circuit potential for the air electrode is increased from 0.98 v (in phosphoric acid) to 1.13 v. GRA

N77-10682# California Univ., Los Angeles. School of Engineering and Applied Science.

ANALYSIS OF POROUS ELECTRODES WITH SPARINGLY SOLUBLE REACTANTS, 3 SHORT TIME TRANSIENTS

Hiram Gu, D. N. Bennion, and John Newman Feb. 1976 41 p refs

(Contract N00014-75-C-0794)

(AD-A024031; UCLA-ENG-7633; TR-1) Avail: NTIS HC A03/MF A01 CSCL 10/3

A mathematical model which describes the operation of porous battery electrodes has been developed. It includes short time transient behavior of electrolyte concentration, porosity, current distribution, reaction rate, and detailed solution diffusion descriptions of sparingly soluble reactant. Calculations were made for constant current (50 mA/sq cm and 25 mA/sq cm) charging and discharging of Ag/AgCl electrodes. Results of calculations indicate that the concentration of the electrolyte, KCl, inside the porous electrode plays an important role in the performance of the electrode. During charging, the electrolyte concentration falls in the depth of the electrode, thereby decreasing the solution electrical conductivity. Reaction penetration depth on charging is very shallow, less than 0.3 mm, for the current densities investigated. On discharging, the electrolyte concentration in the depth of the electrode increases. Consequently, the electrical conductivity of the solution as well as the solubility of AgCl increases. A high reaction rate in the depth of the electrode is

possible even at high current discharge. Charge utilization over 90% is predicted if the charge is stored uniformly by employing a slow charging rate. GRA

N77-10683# EIC, Inc., Newton, Mass.
LITHIUM-INORGANIC ELECTROLYTE BATTERIES Quarterly Report, 16 Sep. - 15 Dec. 1975
Joseph R. Driscoll, Gerhard L. Holleck, David E. Toland, and S. Barry Brummer Mar. 1976 53 p refs
(Contract DAAB07-74-C-0030; DA Proj. 1T1-61102-A-34A)
(AD-A024341; C-401-9; ECOM-74-0030-9; QPR-9) Avail: NTIS HC A04/MF A01 CSCL 10/3

In recent years there has been considerable research and development on ambient temperature, high energy density lithium cells. A particularly promising system is based on thionyl chloride, SOCl2. In this case, SOCl2 serves both as solvent and depolarizer for the cell. D cells have delivered 100 Whr/lb and 40 W/lb at the 2.5 hr rate and, as usual, have delivered higher energy densities at slower discharge rates. The purpose of the present program is to study the feasibility of an all-inorganic electrolyte lithium primary battery operable and storable over the temperature range of -40 F to +160 F. The desired energy density is 150 watt-hours per pound of total battery weight and the desired power density is 50 watts per pound. GRA

N77-10684# Energy Research Corp., Danbury, Conn.
FUEL CELL STACKS Semiannual Report, Dec. 1974 - Aug. 1975
S. G. Abens and B. S. Baker Mar. 1976 33 p
(Contract DAAK02-74-C-0367)
(AD-A024216; ERC-7396-S) Avail: NTIS HC A03/MF A01 CSCL 10/2

Processes for the manufacture of phosphoric acid fuel cell components are described. Electrodes, matrices, and bipolar gas distribution plates for use in fuel cells with an active area of about 0.4 sq. ft. have been fabricated. Initial performance of 10-cell stacks has been studied with pure and co-containing hydrogen as fuel. Author (GRA)

N77-10685# Boston Univ., Mass. Dept. of Chemistry.
PHOTOCHEMICAL CONVERSION OF SOLAR ENERGY Quarterly Progress Report, 1 Jan. - 31 Mar. 1976
Norman N. Lichtin 28 May 1976 26 p refs Prepared in cooperation with Exxon Res. and Eng. Co., Linden, N. J.
(Grants NSF AER-72-03579-A05; NSF GI-38103)
(PB-255703/1; NSF/RANN/SE/AER-72-03579/A05; NSF/RA-760163) Avail: NTIS HC A03/MF A01 CSCL 07E

Ohmic resistance of the SnO2 electrode of the iron-thionine (TH+) TI-TL SnO2/Pt cell was shown to contribute to current losses. Thin TiO2 layers reduced with H2 at 500C provide a promising selective anode for the iron-TH(+) cell. Tuluidine blue O shows photogalvanic activity comparable to that of TH(+). Substantial sensitization to the blue of the photogalvanic activity of TH(+), methylene blue and azure A were demonstrated for a number of dyes, of which Rhodamine 6G is the most effective sensitizer. The dependence of the composition and kinetics of decay of the photostationary state of acidic iron-TH(+) solutions on solvent anions and initial concentrations of solutes was measured and correlated with rates of elementary reactions. GRA

N77-10686# Institute of Gas Technology, Chicago, Ill. Applied Combustion Research.
BURNER DESIGN CRITERIA FOR CONTROL OF NOx FROM NATURAL GAS COMBUSTION. VOLUME 1: DATA ANALYSIS AND SUMMARY OF CONCLUSIONS Final Report, Jun. 1973 - Sep. 1975
D. R. Shoffstall Apr. 1976 204 p
(Contract EPA-68-02-1360)
(PB-254167/0; EPA-600/2-76-098-a-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 13A

An analysis and details are given of trials conducted with natural gas to determine the relationship between combustion aerodynamics and pollution emission characteristics of industrial burners. Three burner types were studied (kiln, ported baffle, and movable vane boiler), based on relative gas load and estimated total industrial emissions. Experimental measurements on a pilot-scale furnace included baseline characterization of each burner and variation of primary operating parameters (air preheat, air/fuel ratio, firing rate, heat release rate, position of gas nozzle in burner block, and air swirl intensity). Additional emissions data were gathered for suspected control conditions (fuel injector design, flue gas recirculation, fuel/air momentum ration, and burner block angle). It also describes in detail the experimental facility and sampling probes used to collect the data. GRA

N77-10687# National Bureau of Standards, Washington, D.C. Center for Building Technology.
ANALYSIS OF SOLAR ENERGY SYSTEM FOR THE GSA DEMONSTRATION OFFICE BUILDING AT MANCHESTER, NEW HAMPSHIRE Final Report
Tamami Kusuda, Stanley T. Liu, John W. Bean, and James P. Barnett 1 Mar. 1976 34 p refs
(PB-254179/5; NBSIR-76-1056) Avail: NTIS HC A03/MF A01 CSCL 13A

The effect of solar collector sizes and the amount of storage on the overall energy consumption of a building was determined. GRA

N77-10688# National Conference of State Legislatures, Washington, D.C.
ANALYSIS OF STATE SOLAR ENERGY OPTIONS
R. G. Jones, Helen M. Sramek, and Joette M. Pelster Jun. 1976 66 p refs
(Contract FEA-CO-12-60496-00)
(PB-254730/5; FEA/E-76/302) Avail: NTIS HC A04/MF A01 CSCL 13A

Criteria are evaluated for use by state governments in considering actions to stimulate the solar market. Areas discussed are solar market economics, tax incentives, and solar energy and electric utilities. GRA

N77-10689# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
RESEARCH ON SOLAR ENERGY STORAGE SUBSYSTEMS UTILIZING THE LATENT HEAT OF PHASE CHANGE OF PARAFFIN HYDROCARBONS FOR THE HEATING AND COOLING OF BUILDINGS Annual Report
John A. Bailey, James C. Mulligan, Chang-Kwang Liao, Selcuk I. Guceri, and M. Krishna 1976 138 p refs
(Grant NSF GI-44381)
(PB-254665/3; NSF/RA-760100) Avail: NTIS HC A07/MF A01 CSCL 10A

An analytical and experimental research program designed to assess the potential of a solar energy storage subsystem (thermal capacitor) using the latent heat of fusion of paraffin hydrocarbons for the heating and cooling of buildings is described. An idealized model of a flat plate thermal capacitor based on uniaxial heat conduction with a change of phase and an absence of natural convection in the phase change material is assumed. Analyses are presented for the premelting, melting, and postmelting regimes. An experimental system consisting of a prototype thermal capacitor, fluid flow control unit, and hydraulic pumping system is described. GRA

N77-10690# Urban Systems Research and Engineering, Inc., Cambridge, Mass.
BASELINE ENERGY FORECASTS AND ANALYSIS OF ALTERNATIVE STRATEGIES FOR AIRLINE FUEL CONSERVATION
Jul. 1976 199 p
(Contract FEA-C-04-50088-00)
(PB-255351/9; FEA/D-76/026; FEA/D-CP-48) Avail: NTIS HC A09/MF A01 CSCL 10A

Baseline forecasts of airline activity and energy consumption to 1990 were developed to evaluate the impact of fuel conservation strategies. Alternative policy options to reduce fuel consumption were identified and analyzed for three baseline levels of aviation activity within the framework of an aviation activity/energy consumption model. By combining the identified policy options, a strategy was developed to provide incentives for airline fuel conservation. Strategies and policy options were evaluated in terms of their impact on airline fuel conservation and the functioning of the airline industry as well as the associated social environmental, and economic costs. GRA

N77-10104*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH-EFFICIENCY SOLAR CONCENTRATOR
F. L. Lansing and J. Dorman *In its* The Deep Space Network 15 Oct. 1976 p 99-109 ref (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 10A

N77-10105*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A TWO-DIMENSIONAL FINITE DIFFERENCE SOLUTION FOR THE TRANSIENT THERMAL BEHAVIOR OF TUBULAR SOLAR COLLECTOR
F. L. Lansing *In its* The Deep Space Network 15 Oct. 1976 p 110-127 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 10A

N77-10341*# George Washington Univ., Washington, D.C.
SOLAR ENERGY STORAGE AND UTILIZATION
S. W. Yuan and A. M. Bloom *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1235-1246 (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10342*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOLAR HOT WATER SYSTEMS APPLICATION TO THE SOLAR BUILDING TEST FACILITY AND THE TECH HOUSE
Ross L. Goble, Ronald N. Jensen, and Robert C. Basford *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1237-1246 (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 10A

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N77-10691*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TEMPERATURE DEPENDENCY OF THE PHOTOABSORPTION CROSS SECTION FOR CF2CI2
Charles A. Boitnott Oct. 1976 13 p refs
(NASA-TM-X-73177; A-6759) Avail: NTIS HC A02/MF A01 CSCL 13B

The photoabsorption cross section for CF2CL2 is measured at 297 K and 200 K. Cross sections are obtained for the ground and first two vibrationally excited states, allowing for a determination of the photoabsorption as a function of temperature over the range of stratospheric interest. Author

N77-10692# California Univ., Livermore. Lawrence Livermore Lab.
ENVIRONMENTAL MONITORING PROBLEM: OPTIMAL SOLUTIONS FOR CONTROL AND SURVEILLANCE APPLICATIONS IN THE CASE OF INFREQUENT SAMPLING
Kenneth D. Pimentel Mar. 1976 10 p refs Presented at Conf. on Modelling of Environ. Systems, Amagi-Tokyo, 26 Apr. 1976
(Contract W-7405-eng-48)
(UCRL-775286; Conf-760417-1) Avail: NTIS HC A02/MF A01

Environmental monitoring for environmental feedback control applications and for surveillance or pollutant limit violation detection are considered. The main results are for the special case of infrequent sampling. If the required measurements are spaced far enough apart in time, certain terms in the estimation error equations dominate the asymptotic response yielding mathematically elegant solutions for infrequent sampling monitors. ERA

N77-10693# California Univ., Livermore. Lawrence Livermore Lab.
LONG-PATH OPTICAL MONITORING OF URBAN AIR POLLUTION
T. R. Galloway Aug. 1975 144 p refs
(Contract W-7405-eng-48)
(UCRL-51898) Avail: NTIS HC A07/MF A01

Long path spectral extinction coefficients were obtained over the San Francisco Bay Area by tracking photometric standard stars from the zenith down to the near horizon. A model of an urban atmosphere was formulated that includes stratospheric, tropospheric, and regional contributions from Rayleigh scattering, ozone, nitrogen oxides, particulates, and aerosols. The extinction coefficients on a global scale were shown to vary systematically from those at Chabot Observatory in Oakland to those at Mauna Kea, Hawaii according to the site altitude and the distance from the nearest urban center affecting the tropospheric ozone, NO3, and aerosol content. From the Chabot extinction data, correlations were developed for mean aerosol densities and mass loadings. These data were then used to predict particle size distributions. Simultaneous measurements were made of the major air filter elements, which were found to correlate with atmospheric opacity. Local nephalometer aerosol extinction coefficients showed excellent correlation with the aerosol extinction derived from the long path optical measurements. Finally, some feasibility experiments with high resolution spectroscopy via the long path were conducted. ERA

N77-10694# Brookhaven National Lab., Upton, N.Y.
INDIVIDUAL AIR POLLUTION MONITORS: AN ASSESSMENT OF NATIONAL RESEARCH NEEDS
M. G. Morgan and S. C. Morris Jan. 1976 38 p refs
(Contract E(30-1)-16)
(BNL-50482) Avail: NTIS HC A03/MF A01

The deliberations and conclusions of a workshop on national research needs in individual air pollution monitors for ambient air are reported. The weakest link in air pollution health effects studies is knowledge of individual exposure. Monitors which can be easily carried or worn are necessary to the design or performance of definitive studies of the health effects of air pollution. The report includes discussion of how individual monitors would be used if they were available, an outline of their desired operating characteristics, and a description and first order evaluation of the instrumentation technologies which might form the basis for such devices. A five year national R and D investment of 7.5 to 8 million dollars is recommended. ERA

N77-10695# Brookhaven National Lab., Upton, N.Y.
HEALTH EFFECTS OF AIR POLLUTION
L. D. Hamilton 1975 52 p refs Presented at ERDA-wide Conf. on Computer Support on Environmental Sci. and Analysis, Albuquerque, N. Mex., 9 Jul. 1975
(Contract E(30-1)-16)
(BNL-20743; Conf-750706-12) Avail: NTIS HC A04/MF A01

Air pollution from energy sources is evaluated in perspective of total air pollution. Tables summarize estimated air pollutants by weight nationwide for transportation system (cars, trucks, buses, trains and planes), fuel combustion in stationary sources including power generation and domestic heating, industrial processes, solid waste disposal and other miscellaneous processes that pollute with sulfur dioxide, carbon monoxide, nitrogen oxides, hydrocarbons, and particulates. Nationwide trends in air pollution are summarized from 1940-1970. Computer techniques for handling the health data are detailed for modeling the health hazards accumulating from individual and combined fuel cycle activity in the energy systems fueled by coal, natural gas, hydroelectric power, fuel oils, nuclear energy, geothermal energy, wood burning, and related waste disposal efforts. ERA

N77-10696# Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.
AIRBORNE SYSTEM FOR MAPPING AND TRACKING EXTENDED GAMMA RAY SOURCES
T. P. Stuart, T. J. Hendricks, G. G. Wallace, and J. R. Cleland 1976 16 p refs Presented at the Symp. on the Development of Nucl. Based Techniques, Vienna, 15 Mar. 1976
(EGG-1183-1685; Conf-760311-3; SM-206/24) Avail: NTIS HC A03/MF A01

An airborne system was developed for mapping and tracking extended sources of airborne or terrestrially distributed gamma ray emitters. The system records 300 channel gamma ray spectral data every three seconds on magnetic tape. Computer programs were written to isolate the contribution from the particular

radionuclide of interest. Aircraft position as sensed by a microwave ranging system is recorded every second on magnetic tape. Measurements of airborne stack releases of A-41 concentrations versus time or aircraft position agree well with computer code predictions. Author (ERA)

N77-10697# California Univ., Livermore. Lawrence Livermore Lab.

METHODS IN ENVIRONMENTAL SAMPLING FOR RADIONUCLIDES

R. C. Ragaini 1 Feb. 1976 16 p refs Presented at Proc. on Radionuclides in the Environment, Palto Alto, Calif., 22 Nov. 1975

(Contract W-7405-eng-48)

(UCRL-77722; Conf-751174-2) Avail: NTIS HC A02/MF A01

Methods of environmental sampling for radionuclides around operational and preoperational nuclear power plants are reviewed. The implications of the established radiation standards and their effect on sampling procedures are examined in detail. Transport mechanisms of radionuclides in liquid effluent, and the deposition of airborne radionuclides onto soil and vegetation are discussed. Water and soil sampling procedures are evaluated. The Lawrence Livermore Laboratory program of terrestial gamma ray surveys at preoperational nuclear power plants is described. ERA

N77-10698# Battelle Pacific Northwest Labs., Richland, Wash.

SOME PROBLEMS IN MEASURING ECOLOGICAL EFFECTS OF CHRONIC LOW LEVEL POLLUTANTS

L. L. Eberhardt 1975 25 p refs Presented to the Subcommittee on Environment and the Atmosphere (Science and Technology Committee of the House of Representatives), 12 Nov. 1975

(Contract AT(45-1)-1830)

(BNWL-SA-5608) Avail: NTIS HC A02/MF A01

The ability of populations to compensate for the effect of some added stress or insult is somehow connected with the self regulation mechanisms exhibited by natural populations. A detailed understanding of the machinery of population regulation is not presently available. The lack of such understanding is considered a limiting factor in studies on the effects of chronic low-level pollutants because it is known that the built-in resiliency of populations can be stretched too far by accumulative stresses. Once this happens it is likely that the population will simply disappear. Lack of suitable data on the abundance of most natural populations constitutes a limiting factor simply because there is no way to be sure of the current status and trend of a population without a reliable history of its past. Full utilization of such population records as are available for assessing pollution effects require also knowledge, about the sensitivity of a given species to particular kinds of insult (and to combinations of different stresses). Given data on these two aspects, long-term records on pollution levels, which apparently are also not always available, are also needed. There is thus a serious lack of baseline data, which limits the ability to draw inferences by correlation, or to test laboratory results against a historical record. ERA

N77-10699# Metaalinstitut TNO, Apeldoorn (Netherlands).

ADVICE ON TREATMENT OF A PAINT REMOVAL BATH CONTAMINATED WITH CHROMIUM AT THE 574 TANK WORKSHOP AT OUD LEUSDEN [ADVIES OVER DE BEHANDELING VAN MET CHROOM VERONTREINIGD ONTLAKBAD BIJ DE 574 TANKWERKPLAATS TE OUD LEUSDEN]

J. vanGarderen, comp. 29 Aug. 1975 17 p In DUTCH

(Contract A71/KL/084)

(M75/96/409; TDCK-66757) Avail: NTIS HC A02/MF A01

Treatment of the waste water of a paint removal bath containing hexavalent chromium, from zinc chromate containing paint, is discussed. The hexavalent chromium is reduced to trivalent chromium using glucose during production. The remaining hexavalent chromium is reduced by sodium dithionite during the waste disposal phase. It is possible to remove the trivalent chromium up to a residual value of approximately 100 ppm by treating the complexated chromium compound with sodium chloride. In order to remain within the water pollution requirements the waste water is discharged slowly, for a period of one or two days, in the sewer through a neutralization tank. ESA

N77-10700# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.

MATHEMATICAL SIMULATION AND EMPIRICAL DETERMINATION OF THE AEROCHEMICAL AND THERMAL ATMOSPHERIC POLLUTION RESULTING FROM ENERGY CONVERSION PROCESSES [MATHEMATISCHE SIMULATION UND MESSTECHNISCHE ERFASSUNG DER BEI ENERGIEWANDLUNGSPROZESSEN AUFTRETENDEN LUFTCHEMISCHEN UND THERMISCHEN BELASTUNG DER ATMOSPHAERE]

H. Fortak and D. Paffrath 1975 20 p refs In GERMAN

(DLR-IB-553-75/1) Avail: NTIS HC A02/MF A01

The prediction of atmospheric pollution effects resulting from power plants using a mathematical-meteorological simulation model with empirically determined input parameters is discussed. The model is aimed at climatological forecasting and takes into account heat, water vapor, and contaminant emission by energy conversion plants. ESA

N77-10701# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.

RESULTS OF AEROSOL MEASUREMENTS DURING THE BOUNDARY LAYER EXPERIMENT GREIV 1 AT MEPPEN IN APRIL 1974 [ERGEBNISSE DER AEROSOLMESSUNGEN BEIM GRENZSCHICHTEXPERIMENT GREIV 1 IN MEPPEN IM APRIL 1974]

D. Paffrath Jul. 1975 18 p In GERMAN

(DLR-IB-553-75/10) Avail: NTIS HC A02/MF A01

Aerosol measurements using airborne equipment are reported in tables and graphs. The data essentially cover vertical particle concentration profiles and the altitude dependency of the mean particle size. ESA

N77-10702# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.

RESULTS OF THE AEROSOL AND SULFUR DIOXIDE MEASUREMENTS NEAR THE NEURATH POWER PLANT IN NOVEMBER 1974 [ERGEBNISSE DER AEROSOL- UND SCHWEFELDIOXIDMESSUNGEN BEIM KRAFTWERK NEURATH IM NOVEMBER 1974]

D. Paffrath and W. Peters Nov. 1975 127 p In GERMAN

(DLR-IB-553-75/16) Avail: NTIS HC A07/MF A01

Results of aerosol and sulfur dioxide measurements are presented in tables and graphs. The measurements were made from a Do-27 aircraft equipped with a TechEcology Particle Counter model 200 and a flame photometer detector Meloy model SA165. The spatial coordinates were determined by radar equipment. The SO2 values are given in ppb, and the aerosol concentrations relate to the particle sizes above 0.5 micron. ESA

N77-10703# Research Inst. for Environmental Hygiene, TNO, Delft (Netherlands). Atmospheric Pollution Div.

FORMATION OF PHOTOCHEMICAL SMOG IN THE NETHERLANDS

Robert Guicherit Sep. 1975 105 p refs In DUTCH; ENGLISH summary

(G-646) Avail: NTIS HC A06/MF A01; Res. Inst. for Environ. Hyg. TNO, Delft, Neth. Dfl. 15

The first phase of an investigation on photochemical smog in the Netherlands is presented. The occurrence of ozone is discussed: measurement methods, concentration of natural source, daily and annual variations, and transport. The occurrence of other secondary air pollution products is dealt with and precursors of ozone are discussed. Effects of meteorological parameters such as sunlight, temperature, humidity, and wind velocity are presented, and social and economic effects of photochemical air pollution are dealt with. Some management aspects are indicated and the mechanism of photochemical smog formation is presented. Possibilities of remedying photochemical air pollution are given. ESA

N77-10704# GCA Corp., Bedford, Mass. Technology Div.

GUIDELINES FOR IDENTIFICATION AND EVALUATION OF LOCALIZED VIOLATIONS OF CARBON MONOXIDE STANDARDS Final Report

Theodore P. Midurski and Alan H. Castaline Jan. 1976 117 p refs
(Contract EPA-68-02-1337)
(PB-252700/0; GCA-TR-75-35-G-Vol-1; EPA-901/9-76-001)
Avail: NTIS HC A06/MF A01 CSCL 13B

Guidelines for identifying and evaluating violations of carbon monoxide air quality standards in the vicinity of streets and highways are presented. The guidelines are provided to facilitate the rapid and efficient review of CO conditions along existing roadway networks, without the need for extensive air quality monitoring, and are based upon the use of limited traffic data. Preliminary screening, performed with simple monographs, simply identifies those locations with the potential to violate CO standards; no quantitative estimate of CO concentrations results from preliminary screening. Verification screening allows for consideration of additional site specific conditions and provides quantitative estimates of maximum CO concentrations. Both screening procedures are performed manually and are based upon the EPA Indirect Source Review Guidelines. Data collection procedures, computation techniques, and forms are recommended, and examples are provided. GRA

N77-10705# GCA Corp., Bedford, Mass. Technology Div.
DEVELOPMENT OF GUIDELINES FOR IDENTIFICATION AND EVALUATION OF LOCALIZED VIOLATIONS OF CARBON MONOXIDE STANDARDS Final Summary Report
Alan H. Castaline, Theodore P. Midurski, Robert M. Patterson, and Arnold J. Soolman Jan. 1976 213 p refs
(Contract EPA-68-02-1337)
(PB-252701/8; GCA-TR-75-35-G-Vol-2; EPA-901/9-76-002)
Avail: NTIS HC A10/MF A01 CSCL 13B

The development of a series of guidelines for the identification and evaluation of localized violations of carbon monoxide air quality standards from motor vehicle traffic is described. Guidelines for first-stage analysis (screening) were based upon the EPA indirect Sources Guidelines and generalized traffic data. Guidelines for second-stage analysis specify the use of available air quality models. Guidelines for selecting among alternative control measures describe several alternative measures, quantify their air quality impact with data from the literature and from new analyses, and describe their other impacts. Guidelines were tested on 51 locations in Waltham, Mass., data for which is presented. GRA

N77-10706# National Oceanic and Atmospheric Administration, Boulder, Colo. Marine Ecosystems Analysis Program Office.
EVALUATION OF PROPOSED SEWAGE SLUDGE DUMPSITE AREAS IN THE NEW YORK BIGHT
Feb. 1976 219 p refs
(PB-253727/2; NOAA-TM-ERL-MESA-11; NOAA-76031225)
Avail: NTIS HC A10/MF A01 CSCL 13B

Significant features of the New York Bight's midshelf environment are discussed and alternative sewage sludge dumpsite areas 1-A and 2-A are described. The effects of dumping sewage sludge at any interim dumpsite in this environment are evaluated. Specific recommendations relative to dumping operations and monitoring activities are made. GRA

N77-10707# Electric Power Research Inst., Palo Alto, Calif.
THE PROCEEDINGS OF THE NOx CONTROL TECHNOLOGY SEMINAR
Feb. 1976 436 p refs Seminar held at San Francisco, 5-6 Feb. 1976
(PB-253661/3; EPRI-SR-39) Avail: NTIS HC A19/MF A01 CSCL 07A

On February 5 and 6, 1976, EPRI sponsored a conference in San Francisco on the status of technology for control of oxides of nitrogen from power generation facilities. Coal-fired steam generators, gas turbines and synthetic fuel NOx emissions were covered during the two-day seminar. Representatives of electric utilities, regulatory agencies, academic institutions, research organizations and other industries were present. The purpose of this seminar was three fold: first, to acquaint the utility industry with stringent NOx emission standards for fossil fueled power plants currently under consideration by regulatory bodies; second, to evaluate the current state of the art for NOx control; and finally, to assess future technical options for NOx control and, where possible, to present their economic consequences. GRA

N77-10708# Abcor, Inc., Cambridge, Mass. Walden Research Div.
GROWTH EFFECTS OF MAJOR LAND USE PROJECTS. VOLUME 1: SPECIFICATION AND CAUSAL ANALYSIS OF MODEL Final Report
Frank Benesh, Peter Guldberg, and Ralph DAgostino May 1976 222 p refs
(Contract EPA-68-02-2076)
(PB-255301/4; C-781-a-Vol-1; EPA-450/3-76-012-a-Vol-1)
Avail: NTIS HC A10/MF A01 CSCL 13B

A research program is reported whose goal is to formulate a methodology to predict air pollutant emissions resulting from the construction and operation of two types of major land use projects, large residential projects and large concentrations of employment (i.e., office parks and industrial parks). Emissions are quantified from the major project, from land use induced by the major project, from secondary activity occurring off-site (i.e., generation of electricity by utilities), and from motor vehicle traffic associated with both the major project and its induced land uses. The development of a model is documented to predict the induced land use from such major projects. It discusses the theoretical basis of the model, the specification of equations that model the theory, and the causal analysis of the equations. Sample selection and data collection are also discussed. GRA

N77-10709# Abcor, Inc., Cambridge, Mass. Walden Research Div.
GROWTH EFFECTS OF MAJOR LAND USE PROJECTS. VOLUME 2: COMPILATION OF LAND USE BASED EMISSION FACTORS Final Report
Frank Benesh Jun. 1976 114 p refs
(Contract EPA-68-02-2076)
(PB-255302/2; C-781-b-Vol-2; EPA-450/3-76-012-b-Vol-2)
Avail: NTIS HC A06/MF A01 CSCL 13B

Growth effects of major land use projects is a research program whose goal is to formulate a methodology to predict air pollutant emissions resulting from the construction and operation of two types of major land use projects, large residential projects and large concentrations of employment (i.e., office parks and industrial parks). Emissions are quantified from the major project, from land use induced by the major project, from secondary activity occurring offsite (i.e., generation of electricity by utilities), and from motor vehicle traffic associated with both the major project and its induced land uses. The development of a set of land use based emission factors (i.e., emissions per unit of building floor area or per dwelling unit) are presented that are used to estimate emissions from the induced land uses and secondary activities. To accomplish this, energy consumption in several categories of buildings is quantified. The emission sources may be principally categorized as follows: Stationary source emissions occurring on the site of the major project (e.g., the on-site combustion of fuel oil for space heating needs); stationary source emissions occurring at the land use induced by the major project (e.g., the on-site combustion of fuel oil for space heating needs); and secondary (i.e., occurring off-site) stationary source emissions (e.g., the combustion of fuel oil at the local electric utility to serve the electricity demand of the major project and induced land uses). GRA

N77-10710# Temple, Barker and Sloane, Inc., Wellesley Hills, Mass.
ECONOMIC AND FINANCIAL IMPACTS OF FEDERAL AIR AND WATER POLLUTION CONTROLS ON THE ELECTRIC UTILITY INDUSTRY. EXECUTIVE SUMMARY Final Report
May 1976 44 p
(Contract EPA-68-01-2803)
(PB-254307/2; EPA-230/3-76-013) Avail: NTIS HC A03/MF A01 CSCL 13B

The combined effect of all of EPA's direct regulatory programs on the electric utility industry was examined. The study focused on the determination of changes in the financial profile of the electric utility industry which are likely to result from federal air and water pollution controls for the 1975-1990 period. GRA

N77-10711# Temple, Barker and Sloane, Inc., Wellesley Hills, Mass.
ECONOMIC AND FINANCIAL IMPACTS OF FEDERAL AIR AND WATER POLLUTION CONTROLS ON THE ELECTRIC UTILITY INDUSTRY Final Technical Report
May 1976 515 p
(Contract EPA-68-01-2803)
(PB-254308/0; EPA-230/3-76-013-f) Avail: NTIS HC A22/MF A01 CSCL 13B

Changes in the financial profile of the electric utility industry which are likely to result from federal air and water pollution controls for the 1975-1990 period are discussed. Operating and financial projections at the national and regional levels are provided and the financing needs and problems of the industry are considered in the context of trends and cycles in corporate business financing. In addition, secondary impacts of the legislation on major industrial users of electricity are analyzed. GRA

N77-10712# Rutgers Univ., New Brunswick, N.J. Water Resources Research Inst.
METHODS OF ESTIMATING RESIDENTIAL LAND USE FOR WATER RESOURCES MANAGEMENT
Patricia A. Perry May 1976 56 p refs Sponsored by Dept. of Interior
(PB-253956/7; W76-08924; OWRT-A-043-NJ(2)) Avail: NTIS HC A04/MF A01 CSCL 13B

Land use principles and criteria related to water quality and water resources management are reviewed. Existing and potential residential land uses are analyzed at two water resources in New Jersey. Residential land use contributions to non point sources of pollution are generalized. Indirect methods of maintaining water quality standards through land use regulations are outlined. Guidelines for minimization of erosion and runoff and estimates of impervious surface by land use are included. GRA

N77-10713# Research Triangle Inst., Research Triangle Park, N.C.
DEVELOPMENT AND TRIAL FIELD APPLICATION OF A QUALITY ASSURANCE PROGRAM FOR DEMONSTRATION PROJECTS Final Task Report, Jul. - Dec. 1975
James Buchanan Mar. 1976 90 p refs
(Contract EPA-68-02-1398)
(PB-253944/3; EPA-600/2-76-083) Avail: NTIS HC A05/MF A01 CSCL 13B

A project was conducted to: (1) develop a set of quality assurance guidelines for EPA demonstration projects; (2) implement a short-term quality assurance program at the EPA wet limestone scrubber facility at the Shawnee steam/electric plant; and (3) modify the guidelines in light of the Shawnee operating experience. GRA

N77-10714# Midwest Research Inst., Kansas City, Mo.
MEASUREMENT OF ATMOSPHERIC SULFATES: EVALUATION OF THE METHYLTHYMOL BLUE METHOD Final Report
Fred J. Bergman and Michael C. Sharp Mar. 1976 48 p refs
(Contract EPA-68-02-1728)
(PB-253349/5; EPA-600/4-76-015) Avail: NTIS HC A03/MF A01 CSCL 13B

The methylthymol blue (MTB) procedure used by EPA for sulfate analysis was subjected to a ruggedness test. The method was modified to strengthen the procedure where required. A new procedure for extracting sulfates from the filter samples was incorporated. The absorbance for the MTB procedure was established as hyperbolic. The method appears to be reasonably rugged with the exception of phosphate interference, which remains a problem. A potential approach for eliminating the phosphate interference is presented. GRA

N77-10715# Battelle Columbus Labs., Ohio.
CHEMICAL AND PHYSICAL CHARACTERIZATION OF AUTOMOTIVE EXHAUST PARTICULATE MATTER IN THE ATMOSPHERE Annual Summary Report, Nov. 1973 - Aug. 1974
J. F. Foster, D. A. Trayser, E. R. Blosser, and F. A. Creswick 22 Mar. 1976 106 p refs
(PB-253375/0; CRC-APRAC-CAPE-19-70-4; ASR-5) Avail: NTIS HC A06/MF A01 CSCL 13B

Cars were operated on a chassis dynamometer, discharging exhaust into a dilution tunnel, from which samples of diluted exhaust were taken for chemical and physical characterization of suspended particles. Particulate matter was studied in two separate research programs. Results are given from a series of tests on one 1973 catalyst-equipped car, modified for 1975 emission controls, which was operated at steady speeds and on the 1975 Federal Test Procedure (FTP) cycle. Sulfuric acid and sulfur oxide emissions were measured. The characteristics of particles emitted by two 1970 cars, with 1971 engines, using leaded or unleaded fuel and operating without catalysts on the 1972 FTP cycle are described. GRA

N77-10716# Southern California Coastal Water Research Project, El Segundo.
WATER POLLUTION CONTROL ACT OF 1972. ENVIRONMENTAL EFFECTS OF THE DISPOSAL OF MUNICIPAL WASTEWATERS IN OPEN COASTAL WATERS Final Report
Dec. 1975 80 p refs
(Contract WQ5AC098)
(PB-254396/5; NCWQ-75/113) Avail: NTIS HC A05/MF A01 CSCL 13B

Open coastal waters are defined, and their natural background of trace elements is established. Sewage treatment levels and ocean disposal methods are described. The characteristics of pollutants discharged and their likely effects on biological processes are discussed. Tables summarize the sublethal responses of marine animals to trace elements and chlorinated hydrocarbons and the present environmental situation at New York, Los Angeles, Seattle, Honolulu, and Miami. Cost of alternative solutions is discussed. GRA

N77-10717# California Univ., Berkeley. College of Engineering.
THE FORMATION OF NITROGEN OXIDES FROM FUEL NITROGEN Final Report
R. F. Sawyer, N. J. Brown, R. D. Matthews, M. C. Branch, and S. M. Banna Mar. 1976 85 p refs Sponsored by EPRI
(PB-252462/7; EPRI-223-1-FR) Avail: NTIS HC A05/MF A01 CSCL 21B

The chemistry of fuel nitrogen and oxides of nitrogen reactions in combustion was studied. The ability to account quantitatively for all of the nitrogen constituted a major part of this effort. Other studies of fuel-nitrogen chemistry, nitrogen compound measurement, and premixed flame experiments are discussed. GRA

N77-10718# Environmental Protection Agency, Research Triangle Park, N.C.
SMOG CHAMBER CONFERENCE PROCEEDINGS Final Report
Basil Dimitriades Apr. 1976 126 p refs Held at Research Triangle Park, N.C., 24-25 Oct. 1974
(PB-253124/2; EPA-600/3-76-029) Avail: NTIS HC A07/MF A01 CSCL 07E

Smog chamber methodology is reviewed with respect to its present status and utility in developing photochemical pollution control strategies. Measurement of NO and O3 in chamber atmospheres is judged to be statisfactory; measurement of NO2, nonmethane hydrocarbon, and sulfate presented problems. Surface effects and background contamination problems were minimal in large (hundreds of cubic feet) chambers made of Teflon film. Compared to indoor chambers, outdoor chamber operations were less costly and yielded more valid data in some respects. Specific sets of smog chamber data were used to estimate oxidant-related control requirements for California's South Coast Air Basin. Such estimates were judged to be more useful relative to those based on aerometric data analysis in that the role of NOx in oxidant formation was considered quantitatively. Other applications of smog chamber methodology in photochemical air pollution research are discussed. GRA

N77-10719# Harbridge House, Inc., Boston, Mass.
COST ANALYSIS OF TWO AIR QUALITY ATTAINMENT STRATEGIES Final Report
Nancy W. Sheldon, Susan McKittrick, Daniel Garson, and Catherine

Bragg 15 Jun. 1976 71 p refs
(Contract EPA-68-01-1561)
(PB-254182/9; EPA-901/9-76-006) Avail: NTIS HC A04/MF A01 CSCL 13B

The economic costs associated with implementation of two strategies for attainment and short-term maintenance of particulate standards are evaluated. Strategies proposed for application to the City of Worcester are the replacement of marginal burners with more energy efficient modern equipment and the conversion of sources using residual oil to the use of lighter fuels and/or fuels of lower sulfur content. Only the economic costs to owners of affected facilities are involved. GRA

N77-10720# Meteorology Research, Inc., Altadena, Calif.
THE CHEMISTRY, DISPERSION, AND TRANSPORT OF AIR POLLUTANTS EMITTED FROM FOSSIL FUEL POWER PLANTS IN CALIFORNIA Final Report, Sep. - Nov. 1974
T. B. Smith, W. H. White, J. A. Anderson, and S. L. Marsh Nov. 1975 105 p refs
(Contract ARB-3-929)
(PB-254449/2; MR175-FR-1382; ARB-R-3-929-75-48) Avail: NTIS HC A06/MF A01 CSCL 13B

The effects of large, fossil fuel plants on the air quality environment in California were investigated. The program consisted of SF6 tracer releases from three different power plants and downwind sampling of SO2, SF6, and sulfates on the ground and in an instrumented aircraft. NOx and other pollutants were also sampled in the aircraft. With only one major exception the plumes from the plants were confined to the low level mixing layer and impacted at ground levels from 13 to 24km downwind of the plant. An unusual feature of the Haynes-Alamitos studies was the consistency of the plume direction from the plants. The reaction of NO, NO2 and O3 in the plumes occurred rapidly and resulted in ozone deficits in the plumes. The conversion of SO2 to sulfate occurred too slowly to be detected within the downwind distance of the identifiable plumes. GRA

N77-10721# Office of Radiation Programs, Las Vegas, Nev.
EVALUATION OF SAMPLE COLLECTION AND ANALYSIS TECHNIQUES FOR ENVIRONMENTAL PLUTONIUM Final Technical Note
David E. Bernhardt May 1976 153 p refs
(PB-253960/9; ORP/LV-76-5) Avail: NTIS HC A08/MF A01 CSCL 13B

Information concerning sampling and analysis techniques for plutonium in the environment is presented and evaluated. Consideration is given to available techniques and their applicability to various situations, sensitivities of the techniques, and the validity and reproducibility of results. Soil is the primary reservoir for plutonium in the environment but inhalation, with the resulting lung dose, is the primary pathway for human exposure. This evaluation is therefore primarily oriented toward sampling and analysis of soil and air, with secondary consideration of other environmental media. GRA

N77-10722# Battelle Columbus Labs., Ohio.
REDUCTANT GASES FOR FLUE GAS DESULFURIZATION SYSTEMS Final Task Report, May 1974 - Mar. 1976
D. W. Hissong, K. S. Murthy, and A. W. Lemmon May 1976 248 p refs
(Contract EPA-68-02-1323)
(PB-254168/8; EPA-600/2-76-130) Avail: NTIS HC A11/MF A01 CSCL 07A

Study results are presented for use of coal or residual-oil gasification to produce a hydrogen/carbon monoxide-rich gas for use as a reductant for regenerable flue gas desulfurization (FGD) processes. Two different reduction systems are considered: one for the type of FGD process that produces a concentrated SO2 stream; the other, for the type that uses a liquid-phase Claus reactor. Data on the composition of the raw gas from several gasifiers are analyzed. To supplement the data on trace constituents in the gas, thermodynamic calculations were made to determine the equilibrium gas-phase concentrations for a typical coal and typical gasification conditions. GRA

N77-10723# Little (Arthur D.), Inc., Cambridge, Mass.
METHODOLOGY FOR DESIGNATION OF ADJACENT COASTAL STATES Final Report
C. B. Cooper, M. C. Huston, and A. S. Kalelkar 12 Mar. 1976 77 p refs Revised
(Contract DOT-CG-52269-A)
(AD-A024483; ADL-C-78784-20-Rev-1; USCG-WDWP-1-76-Rev-1) Avail: NTIS HC A05/MF A01 CSCL 13/2

This report sets forth the methodology that will be used to identify environmental considerations in the processing of petitions for Adjacent Coastal State status pursuant to Section 9 of the Deepwater Port Act of 1974 (Public Law 93-627). Additionally, it identifies the types and format of data needed for such considerations. Author (GRA)

N77-10724# Naval Surface Weapons Center, White Oak, Md.
DEFENSE TECHNOLOGY FOR ENVIRONMENTAL PROTECTION, VOLUME 1 Final Report, Sep. 1973 - Jun. 1975
Eldon A. Byrd, O. M. Meredith, and Sherman Gee Mar. 1976 133 p refs
(AD-A024536; NSWC/WOL/TR-75-111-Vol-1; EPA-600/2-76-068-a) Avail: NTIS HC A07/MF A01 CSCL 13/2

The report condenses an effort designed to identify and transfer significant technology concerned with air pollution monitoring and control from the Department of Defense (DOD) to the EPA. Included are technology profiles of each DOD laboratory involved in particular work of interest to EPA's Industrial Environmental Research Laboratory-RTP, a bibliography of pertinent DOD documentation, and a description and assessment of how the study was conducted. Author (GRA)

N77-10725# Tereco Corp., College Station, Tex.
SEA-LEVEL MONITORING OF THE INCINERATION OF ORGANIC CHLORIDE WASTE BY M/T VULCANUS IN THE NORTHERN GULF OF MEXICO SHELL WASTE BURN NUMBER 2
10 Jan. 1975 62 p
(Contract EPA-68-01-2829)
(PB-253365/1) Avail: NTIS HC A04/MF A01 CSCL 13B

Shell Chemical Company began to explore alternative methods for the disposal of vinyl chloride during the interval when a land-based incinerator could be fabricated and put into use. The most promising of these alternatives appeared to be incineration of the wastes at sea aboard an incinerator ship such as M/T Vulcanus. A sea level monitoring program to determine whether or not the products of combustion would affect the marine environment adversely is discussed. GRA

N77-10726# Wisconsin Univ., Madison. Dept. of Statistics.
COMPARISON OF FORECASTS AND ACTUALITY
G. E. P. Box and G. C. Tiao May 1975 24 p refs
(Grant DA-ARO(D)-31-124-72-G162)
(AD-A023662; UWIS-DS-75-402) Avail: NTIS HC A02/MF A01 CSCL 13/2

In the analysis of time series data, it is frequently of interest to compare a set of forecasts made at some time point when a change in level is suspected to have taken place with actual observations. This paper discusses various statistical techniques for making such comparisons, and illustrates these techniques in terms of an actual example concerning the monthly averages of atmospheric ozone concentration of Azusa, California. This particular comparison is of interest because new automobile emissions standards that were introduced at the end of 1970. These measures might have reduced ozone below levels expected if no new standards had been introduced. GRA

N77-10727# Illinois Univ., Urbana-Champaign.
EVALUATION OF A LABORATORY MICROCOSM FOR STUDY OF TOXIC SUBSTANCES IN THE ENVIRONMENT Final Technical Report, 1 Jul. 1973 - 31 Dec. 1975
Robert L. Metcalf 1975 72 p refs
(Grant NSF ESR-76-22760)
(PB-252982/4; NSF/RA/E-75-116) Avail: NTIS HC A04/MF A01 CSCL 06T

How a simple model ecosystem technology can yield, at modest expense, a wealth of valuable information about pesticides, drugs, plasticizers, industrial chemicals, carcinogens, and trace metals is described. The value of their laboratory microcosm in prescreening new chemicals at an early stage in their development;

developing 'environmentally congenial products'; and tracing environmental fate and degradation pathways, toxicity, ecological magnification, biodegradability index and unextractable radioactivity. A bibliography containing published results, in research papers and technical reports, is included. GRA

N77-10728# Environmental Monitoring and Support Lab., Las Vegas, Nev. Monitoring Systems Research and Development Div.

CONCENTRATION FACTORS AND TRANSPORT MODELS FOR RADIONUCLIDES IN AQUATIC ENVIRONMENTS. A LITERATURE REPORT Final Report

Robert G. Patzer May 1976 64 p refs
(PB-255097/8; EPA-600/3-76-054) Avail: NTIS HC A04/MF A01 CSCL 06F

The biological concentration of radionuclides in fishwater and marine environments is reviewed. Concentration factors for elements found in organisms are tabulated for plants, invertebrates, and fish in marine and fishwater environs. Models developed to calculate the possible radiation dose delivered to humans from radionuclides released into aquatic environments are also reviewed. GRA

N77-10729# Midwest Research Inst., Kansas City, Mo.

EVALUATION OF MAGNETICS FOR FINE PARTICLE CONTROL Final Task Report, Feb. 1975 - Feb. 1976

K. P. Ananth and L. J. Shannon May 1976 34 p refs
(Contract EPA-68-02-1324)
(PB-255094/5; EPA-600/2-76-133) Avail: NTIS HC A03/MF A01 CSCL 07A

The effectiveness of magnetic agglomeration/separation techniques in enhancing fine particulate capture was examined. Whereas residence times and magnetic fields required to achieve agglomeration via magnetic forces appear to be unrealistic, magnetic separation--especially high gradient magnetic separation--appears to be attractive in principle. GRA

N77-10730# Washington Univ., Seattle.

WATER POLLUTION CONTROL ACT OF 1972. STUDY OF EFFLUENT CHARGES Final Report

Gardner M. Brown, Jr., Allen V. Kneese (New Mex. Univ., Albuquerque), Susan Rose-Ackerman (Yale Univ.), and Otto A. Davis (Carnegie-Mellon Univ.) Jun. 1976 113 p refs Sponsored by the Natl. Commission on Water Quality
(PB-255834/4; NCWQ-75/112) Avail: NTIS HC A06/MF A01 CSCL 13B

Effluent charges are required payments for the use of waste disposing powers of the nation's waters. The economic arguments which form the basis for assessing the desirability of this approach are presented along with a market-like alternative. The case for effluent charges as a device for improving ambient water quality is discussed. GRA

N77-10731# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.

COMPILATION OF AIR POLLUTANT EMISSION FACTORS. SUPPLEMENT

Apr. 1976 59 p refs
(PB-254274/4; AP-42-Suppl-6) Avail: NTIS HC A04/MF A01 CSCL 21B

Emissions data are presented for fuel oil combustion, open burning, heavy-duty, natural-gas-fired pipeline compressor engines, alfalfa dehydrating, sugar cane processing, natural gas processing, and woodworking operations. ERA

N77-10321*# New Brunswick Univ., Fredericton.

NOISE PROPAGATION IN URBAN AND INDUSTRIAL AREAS

Huw G. Davies *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 997-1008 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N77-10732*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

POST SUNSET BEHAVIOR OF THE 6300 A ATOMIC OXYGEN AIRGLOW EMISSION

Robert E. Smith Washington Oct. 1976 161 p refs
(NASA-TN-D-8322; M178) Avail: NTIS HC A08/MF A01 CSCL 04A

A theoretical model of the 6300 A OI airglow emission was developed based on the assumptions that both the charged and neutral portions of the Earth's upper atmosphere are in steady state conditions of diffusive equilibrium. Intensities of 6300 A OI emission line were calculated using electron density true height profiles from a standard C-4 ionosonde and exospheric temperatures derived from Fabry-Perot interferometer measurements of the Doppler broadened 6300 A emission line shape as inputs to the model. Reaction rate coefficient values, production mechanism efficiencies, solar radiation fluxes, absorption cross sections, and models of the neutral atmosphere were varied parametrically to establish a set of acceptable inputs which will consistently predict 6300 A emission intensities that closely agree with intensities observed during the post-sunset twilight period by an airglow observatory consisting of a Fabry-Perot interferometer and a turret photometer. Emission intensities that can only result from the dissociative recombination of molecular oxygen ions were observed during the latter portion of the observational period. Theoretical calculations indicate that contamination of the 6300 A OI emission should be on the order of or less than 3 percent; however, these results are very sensitive to the wavelengths of the individual lines and their intensities relative to the 6300 A OI intensity. This combination of a model atmosphere, production mechanism efficiencies, and quenching coefficient values was used when the dissociative photoexcitation and direct impact excitation processes were contributing to the intensity to establish best estimates of solar radiation fluxes in the Schumann--Runge continuum and associated absorption cross sections. Results show that the Jacchia 1971 model of the upper atmosphere combined with the Ackerman recommended solar radiation fluxes and associated absorption cross sections produces theoretically calculated intensities that more closely agree with the observed intensities than all the other combinations. Author

N77-10733*# Transemantics, Inc., Washington, D.C.

THE ZHAMANSHIN METEORITE CRATER (THE NORTHERN NEAR-ARAL') AND ITS TEKITIKES AND IMPACTITES

P. V. Florenskiy NASA Aug. 1976 32 p refs Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR, Seriya Geologicheskaya (Moscow), no. 10, 1975 p 73-86
(Contract NASw-2792)
(NASA-TT-F-16765) Avail: NTIS HC A03/MF A01 CSCL 08G

The impactite-meteorite hypothesis of the origin of the circular structure of Zhamanshin and the related formations is discussed. Author

N77-10734# Naval Research Lab., Washington, D.C.

EARLY TIME STRIATION STRUCTURING IN IONIZED BARIUM CLOUDS DUE TO THE PRESENCE OF BaO FLOW

S. R. Goldman (Science Applications, Inc., McLean, Va.), A. J. Scannapieco (Science Applications, Inc., McLean, Va.), and S. L. Ossakow Apr. 1976 46 p refs
(NRL Proj. H02-27B; DNA Proj. NWED-QAXHC041)
(AD-A024049; NRL-MR-3269) Avail: NTIS HC A03/MF A01 CSCL 04/1

The wavelength spectrum of striations in ionized barium clouds has been the subject of interest recently. It is somewhat puzzling that striations tend to have wavelengths (perpendicular to the ambient magnetic field) of order 1 km whereas the simplest linear one-dimensional estimates indicate insignificant wavelength

variation of the striation growth rate. Recent calculations explain this behavior on the basis of growth rates obtained when one considers striation modes whose electric field is the same at the E and F layers of the ionosphere as it is at the barium cloud. However other calculations show when one considers the self-consistent modal variation along magnetic field lines with barium clouds the growth rates are if anything slightly increased as the wavelength decreases from 1.0 to 0.1 km.
GRA

N77-10735# Finnish Meteorological Inst., Helsinki.
MAGNETIC RESULTS FROM NURMIJARVI GEOPHYSICAL OBSERVATORY, 1974
1975 32 p
(Rept-16; ISBN-951-697-054-0) Avail: NTIS HC A03/MF A01

Geomagnetic data collected at the Nurmijarvi Geophysical Observatory near Helsinki, Finland are tabulated. Declination, horizontal intensity, vertical intensity, diurnal variation, monthly means, and K and C indices are included. The annual means for the years 1953-1974 are also presented. D.M.L.

N77-10736# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
PC1 TYPE GEOPHYSICAL SIGNAL DETECTION AND ESTIMATION OF THEIR CHARACTERISTIC PARAMETERS [DETECTION DE SIGNAUX GEOPHYSIQUES DE TYPE PC1 ET ESTIMATION DE LEURS PARAMETRES CARACTERISTIQUES]
Gilles deSaintSeine and Jean Francois Tessier 20 Jun. 1975 59 p refs In FRENCH
(CEPHAG-32/75) Avail: NTIS HC A04/MF A01

A procedure to detect PC1 geophysical signals based on the intercorrelation function between a PC1 event parameter and a model signal is described. The maximum likelihood method is described and applied to a linearly frequency modulated signal with regard to estimating problems. A simulation device is described and used to analyze an actual PC1 event. ESA

N77-10737# Lyon Univ. (France). Lab. de Mecanique des Fluides.
LABORATORY SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER [SIMULATION DE LA COUCHE LIMITE ATMOSPHERIQUE EN LABORATOIRE]
J. P. Schon, C. Rey, P. Mery, and J. Mathieu Paris Assoc. Aeron. et Astronautique de France 1976 39 p refs In FRENCH Presented at the 12th Ecole Natl. Super. de Mecan. et d'Aerotech./CEAT Colloq. d'Aerodyn. Appl., Poitiers, France, 5-7 Nov. 1975
(AAAF-NT-76-17; ISBN-2-7170-0395-9) Avail: NTIS HC A03/MF A01; CEDOCAR, Paris FF 25 (France and EEC) FF 29 (others)

The possibility of simulating the atmospheric boundary layer in a wind tunnel was investigated. General equations and similarity parameters are discussed and a schematic representation of the atmospheric boundary layer is given. In connection with the application of atmospheric flow simulation to wind tunnels the following effects are discussed: coriolis effect, Reynolds number effect, and thermal effect. The properties of a stratified laboratory boundary layer were compared with those of the atmospheric surface layer. The study shows that certain characteristics of the lower layers of the atmosphere can be simulated with a wind tunnel, if one restricts oneself to an area of 100 m high and 10 km large. ESA

N77-10738# Kiruna Geophysical Inst. (Sweden).
KIRUNA GEOPHYSICAL DATA Data Summary, Jul. - Sep. 1975
G. Gustafsson, ed. Sep. 1975 52 p
(Rept-75/7-9) Avail: NTIS HC A04/MF A01

Tables of ground-based continuous measurements of upper atmosphere variables, particularly geomagnetic K-indices, all sky camera data, and ionospheric absorption are presented. ESA

N77-10739# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
MEASUREMENT OF MINOR GASEOUS CONSTITUENTS IN THE NATURAL STRATOSPHERE
Marie-Lise Chanin (CNRS, Verrieres-le-Buisson, France), Raymond Chevalerias, Andre Girard, Olga Lado-Bordowski (Paris Univ.), Nicole Louisnard, Andre Marten (Centre Natl. d'Etudes des Telecomun., Issy-les-Moulineaux, France), and Christian Muller (Inst. d'Aeronomie Spatiale de Belg.) 1976 62 p refs In FRENCH; ENGLISH summary Presented to Comite pour l'Anal. des Consequences des Vols Stratospheriques. Report will also be announced as translation
(ONERA-P-1976-1; COVOS-1) Avail: NTIS HC A04/MF A01

In order to predict if stratospheric aircraft could modify the present atmospheric composition and to determine the latter with an accuracy corresponding to the expected perturbations a survey was made of various measuring techniques (ground, aircraft, and balloon) as well as the latest results on minor gaseous species such as ozone, NO, NO2, HNO3, N2O, CH4, CO, water vapor, hydrogen, fluorocarbons, HCl, SO2, and radical OH. Natural and, possibly, artificial variations that may affect the concentrations of the most active gases can now be detected. The present-day methods and the developments of some most promising new ones are discussed. Author (ESA)

N77-10740# National Center for Atmospheric Research, Boulder, Colo.
THE STRATOSPHERE AND MESOSPHERE: DYNAMICS, PHYSICS AND CHEMISTRY. VOLUME 1: PRINCIPAL LECTURES AND SEMINARS Final Report
John H. E. Clark, James R. Holton, Conway B. Leovy, Michael McElroy, and Clive D. Rodgers 1975 447 p refs
(Contract NSF C-760)
(PB-253373/5; NCAR/CQ-4; Rept-1975-ASP-Vol-1) Avail: NTIS HC A19/MF A01 CSCL 04A

A nine week colloquium was held at the National Center for Atmospheric Research in an attempt to assess the status of research on the stratosphere and mesosphere and foresee future trends. Roughly four categories of stratospheric and mesospheric research were discussed: dynamics, chemistry, radiative transfer, and social impacts. A few highlights were: (1) an exposition of the coupling between the upper atmosphere and the biosphere by the nitrification and denitrification cycles of the biosphere which result in the production of nitrous oxide - an important ingredient in the chemical cycle of ozone; (2) the revelation of new satellite hardware and software developments that will permit observations of the upper atmosphere to a level heretofor considered unachievable; (3) realization of the fact that several possibly severe environmental problems affecting the ozone layer still require the dedication of considerable effort to determine their severity. GRA

N77-10741# Colorado State Univ., Fort Collins. Engineering Research Center.
INPUT DATA FORMATS FOR ALLUVIAL CHANNEL EXPERIMENTS Final Report
Khalid Mahmood, Tariq Masood, and Gary L. Eyster May 1976 214 p
(Grants NSF ENG-72-00274-A01; NSF OIP-75-15976)
(PB-254230/6; CER75-76KM-TM-GLE39) Avail: NTIS HC A10/MF A01 CSCL 08H

Various experiments covering hydraulic, morphologic and sediment characteristics of alluvial channels are being conducted on the Link Canals of Pakistan. Data from these experiments are to be punched on cards for use on digital computers. The formats have been designed with enough flexibility to cater for any variation that may occur within the scope of the experiment. GRA

N77-10742# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
AN EMPIRICAL INTERPRETATION OF THE EFFECTS OF TOPOGRAPHY ON GROUND MOTION OF THE SAN FERNANDO, CALIFORNIA, EARTHQUAKE, 9 FEBRUARY 1971 Final Report
Frank K. Chang Mar. 1976 40 p refs
(AD-A024056; WES-MP-S-76-1) Avail: NTIS HC A03/MF A01 CSCL 08/11

This study attempts to determine site effects on earthquake ground motion and the correlation between acceleration and/or velocity generated during the San Fernando Earthquake and topography of the San Gabriel Mountain range. It was found that the contours of peak acceleration and peak velocity generally

follow the topography of the San Gabriel Mountain range. The topographical effects on the ground motion could be interpreted in a simple manner as a function of elevation and direction of wave transmission path. The elevation and direction become the dominant factors in the distribution of the ground motion in the near field. A simple, practical method for calculating the bedrock motion using the ground motion-elevation gradient has been applied in the area south of Kagel Mountain and north of Santa Monica Mountain, in the San Fernando Valley. This method is validated using after-shock data. This ground motion-elevation gradient method was applied to an area where the topography has its highest elevation at the epicentral region and decreases in elevation to the surrounding locations in the near field (within 30 km). In any case, when the epicenter occurs at an elevation lower than the elevation of the surrounding area, this gradient method may not be applicable and must be tested for this alternate condition. GRA

N77-10743# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

STATE OF THE ART FOR ASSESSING EARTHQUAKE HAZARDS IN THE UNITED STATES. REPORT 5: PLATE TECTONICS AND EARTHQUAKE ASSESSMENT

Jack L. Walper Mar. 1976 110 p refs

(AD-A023967; WES-MP-S-73-1-5) Avail: NTIS HC A06/MF A01 CSCL 08/11

The emerging theory of plate tectonics, embodying continental drift, seafloor spreading, transform faults, subduction of lithospheric plates, and other basic tenets, provides earth scientists with a reasonably coherent and workable explanation of the occurrence and distribution of earthquakes. It explains the tectonic origin of belts of major seismic activity throughout the United States and provides a consistent pattern into which focal mechanisms of major earthquakes can be fitted. It provides a framework into which a wide variety of observations of geology and geophysics can be assimilated. In short, it is a unifying concept long sought by earth scientists. GRA

N77-10744# Teledyne Industries, Inc., Garland, Tex.

S/P TRAVEL TIME RATIO IN CENTRAL ASIA Annual Report, 1 Oct. 1973 - 30 Jun. 1974

Jack G. Swanson Nov. 1974 58 p refs

(Contract F44620-74-C-0021; ARPA Order 1827)

(AD-A024289; TR-74-16; AFOSR-76-0334TR) Avail: NTIS HC A04/MF A01 CSCL 08/11

The S/P travel time ratio for intermediate depth Hindu-Kush earthquakes and shallow earthquakes in the Hindu-Kush, Pamir, and Tien Shan regions is investigated, using S and P arrival times at 6 World Wide Standard Seismograph Network stations and 19 other close-in stations. For intermediate depth earthquakes, station mean values of the ratio average 1.78, ranging from 1.76 to 1.81. The ratio increases slowly with increasing distance over the range 4.5 to 13 degrees and increases rapidly with decreasing distance for distances less than 4.5 degrees. Variation of the ratio with focal depth is weak. For shallow earthquakes, station mean values of the S/P travel time ratio average 1.78, ranging from 1.75 to 1.83. For the distance range 6.5 to 14 degrees, variation of the ratio with distance is weak, and for distances less than 6.5 degrees the ratio increases with decreasing distance. The S/P travel time ratio increases with increasing focal depth, the depth dependence being stronger at closer distances. GRA

N77-10745# Teledyne Geotechnical, Alexandria, Va. Seismic Data Analysis Center.

ADDITIONAL INVESTIGATION OF EARTHQUAKES WITH LOW M SUB S TO M SUB B RATIOS IN THE TIBET-HIMALAYA REGION

D. M. Clark, E. T. Sweetser, and Zoltan A. Der 10 Jul. 1975 69 p refs

(Contract F08606-76-C-0004; ARPA Order 1620)

(AD-A023949; SDAC-TR-75-2-Suppl) Avail: NTIS HC A04/MF A01 CSCL 08/11

Further analysis of the anomalous events in the eastern Himalaya region with an expanded set of stations shows that the M sub s values of these events are indeed low compared to m sub b. Other characteristics of these events indicate, however, that all these events are earthquakes rather than explosions. Dilatational first motion for P waves, long period S to Rayleigh, short period S to P wave amplitude ratios are characteristic of earthquakes. Readings of the pP phase where available as well as epicenter calculations indicate that the anomalous event hypocenter are shallow, i.e., less than 80 km. Data quality did not permit the refinement of epicenter locations. A search for additional anomalous events with respect to M sub s - m sub b in a wider area in the Himalayan-Tibet region indicated that there are no other contiguous areas containing anomalous events in this region beyond those already found. Author (GRA)

N77-10746# Royal Norwegian Council for Scientific and Industrial Research, Kjeller.

NORWEGIAN SEISMIC ARRAY (NORSAR), PHASE 3 Semiannual Technical Report, 1 Jul. - 31 Dec. 1975

K. A. Berteussen 29 Jan. 1976 82 p refs

(Contract F08606-76-C-0001; ARPA Order 2551)

(AD-A023905; NORSAR-Scientific-1-75/76) Avail: NTIS HC A05/MF A01 CSCL 08/11

Contents: Operation, performance, improvements, and maintenance activity; Documentation developed; Summary of special and technical reports/papers prepared; (P-wave velocities in the upper mantle beneath Fennoscandia and Western Russia, Determination of the 3-dimensional seismic structure of the lithosphere under Montana LASA and under the USGS Central California Seismic Array, origins of precursors to P'P', an analysis of Rayleigh waves from Novaya-Zemlya explosions, NORSAR operational capabilities, event detectability of seismograph stations in Fennoscandia, on the M sub s-m sub b relationship of earthquakes, An improved discriminant using spectral estimates for surface waves, the seismicity of Fennoscandia, precise monitoring of seismic velocities). GRA

N77-10747# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Applied Mathematics.

RESEARCH IN SEISMOLOGY Final Report, 1 Apr. 1973 - 31 Mar. 1975

Ari Ben-Menahem 1 Mar. 1976 90 p refs

(Grant AF-AFOSR-2528-73; ARPA Order 1795)

(AD-A023685; AFGL-TR-76-0049) Avail: NTIS HC A05/MF A01 CSCL 08/11

Research in seismology during the period April 1973 to March 1975 was concerned with the mechanisms and focal processes of Asian earthquakes, meteor impacts, and explosions. The seismicity, tectonics, and structure of the Afro-Eurasian junction, a complex region of relatively low seismic activity was clarified in terms of the breaking of an incoherent plate. Theoretical seismograms for real earth and source models were applied to earthquake dislocation sources and to low-magnitude earthquakes and crustal structure analyses in the northern Red Sea region. Generalized ray theory and reflection and transmission coefficients were applied to surface and shallow seismic sources in multi layered spherical earth models. Elastic wave motion processes across vertical discontinuities were studied.

Author (GRA)

N77-10748# Lamont-Doherty Geological Observatory, Palisades, N.Y.

PLATE TECTONICS AND THE DISCRIMINATION OF UNDERGROUND EXPLOSIONS FROM EARTHQUAKES Final Report, 1 Sep. 1971 - 30 Sep. 1975

Andrew J. Murphy Sep. 1975 49 p refs

(Contract F19628-71-C-0245; ARPA Order 1975)

(AD-A023684; AFGL-TR-76-0032) Avail: NTIS HC A03/MF A01 CSCL 08/11

The following work was undertaken during this contract: (1) Develop long-period seismic instrumentation techniques with emphasis on increasing sensitivity and on discriminating against noise; (2) Investigate the general characteristics of seismograms with emphasis on studies of higher mode surface waves, core phases, and multiples of P and S and methods to selectively enhance these phases; (3) Investigate aspects of the new global tectonics relevant to the problems of detection and identification of seismic events and of selecting optimum sites for seismic instrumentation; (4) Using large array data, conduct detailed studies of wave propagation, of source characteristics, and of surface and body waves of short and long periods originating at teleseismic distances with particular emphasis of regions with

complicated crust and mantle structure such as island arcs; (5) Conduct studies of near earthquakes and explosives to determine properties of the source, or the propagation path of the crust and upper mantle in the vicinity of explosions and shallow earthquakes; (6) Develop high-speed computational techniques for the solution of associated computational problems; (7) Conduct a comprehensive seismic and geologic study of anomalous and intraplate earthquakes events falling within the explosion discrimination, their respective tectonic setting and methods of their positive identification; and (8) Develop earth models of continent-continent collision zones in Europe, Asia and South America, according to recent concepts of plate tectonics. GRA

N77-10749# Nevada Univ., Reno.
NEAR FIELD SMALL EARTHQUAKE LONG PERIOD SPECTRUM Final Report, 1 Apr. 1973 - 30 Nov. 1975
William A. Peppin and Alan Ryall Apr. 1976 58 p refs
(Contract F44620-72-C-0069; ARPA Order 2134)
(AD-A024359; AFOSR-76-0502TR) Avail: NTIS HC A04/MF A01 CSCL 08/11

The authors compute displacement spectra of explosion and earthquake seismograms in an attempt to study source parameters. The explosion data are at odds with several recent source theories for explosions (e.g. flat P-wave spectra from .025 to 1.5 Hz). These data are consistent with a study of trans-Sierra earthquakes in that the spectral corner frequency appears to be controlled by the source time duration. These data should stimulate the investigation of source models for which the corner frequency measures the source time duration and not the source dimension. GRA

N77-10750# Cornell Univ., Ithaca, N.Y. Dept. of Geological Sciences.
INTEGRATED GEOPHYSICAL AND GEOLOGICAL STUDY OF EARTHQUAKES IN NORMALLY ASEISMIC AREAS Final Report
Jack E. Oliver, Bryan L. Isacks, and James York, comp. 1976 262 p refs
(Grant AF-AFOSR-2494-73; ARPA Order 1827)
(AD-A024344; AFOSR-76-0513TR) Avail: NTIS HC A12/MF A01 CSCL 08/11

Information from precise leveling, sea level observations, geomorphology, photogeology, the sedimentary record, igneous activity, faulting, and theoretical geomechanics are brought to bear on understanding intraplate tectonics, especially in the eastern United States and China. Releveling data indicate vertical movements much faster than average geologic rates and possible movements on concealed faults. Intraplate faulting in the eastern U.S. and China extend the seismic record through Quaternary and earlier times. Author (GRA)

N77-10751# Lincoln Lab., Mass. Inst. of Tech., Lexington.
STATISTICS OF GLOBAL IR ATMOSPHERIC TRANSMISSION
Anthony P. Modica and Herbert Kleiman 3 Mar. 1976 101 p refs
(Contract F19628-76-C-0002; ARPA Order 2752)
(AD-A024311; TT-7; ESD-TR-76-67) Avail: NTIS HC A06/MF A01 CSCL 20/6

RAND weather data tapes have been used to obtain statistics of visibility, relative humidity and cloud ceiling heights for weather stations throughout the Northern Hemisphere to generate global probabilities for atmospheric attenuation in the infrared spectral region. The present analysis predicts seasonal probabilities for horizontal sea level transmission losses for several narrow IR bands (1.0-1.2), (3.8-4.2), (8.0-11.5 micrometers) and four laser lines (1.06), (3.83), (4.73) and (10.6 micrometers). The results also include cloud-free-line-of-sight probabilities and attenuation losses through rain. Author (GRA)

N77-10752# Meteorology Research, Inc., Altadena, Calif.
THE DEVELOPMENT OF AN AIRBORNE WATER SAMPLER
Richard G. Hooper, Steven M. Howard, and George J. Woffinden Jul. 1975 198 p refs
(Contract F19628-75-C-0083; AF Proj. 8620)
(AD-A024409; MRI-75-FR-1354; AFGL-TR-76-0074) Avail: NTIS HC A09/MF A01 CSCL 04/1

The Meteorology Research, Inc. (MRI) Total Water Content Instrument (TWCI) is an aircraft-mounted sampler for near real-time mass measurements of ice and water drops in the atmosphere. Its high volume sampling rate of 39 cu m per minute assures a representative sample. Hydrometeors are collected on an impaction surface that is continually washed with a flow of silicone fluid. The fluid carries the sample through a capacitance detector cell. Changes in capacitance are directly proportional to the water fraction in the cell. Performance comparisons were made between the TWCI and the Particle Measurement Systems optical instruments. These comparisons included flight testing aboard a Piper Navajo aircraft.
Author (GRA)

N77-10240*# Norwegian Geotechnical Inst., Oslo.
MATHEMATICAL MODELLING OF UNDRAINED CLAY BEHAVIOR
Jean-Herve Prevost and Kaare Noeg *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 95-102 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10264*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
ROCK FAILURE ANALYSIS BY COMBINED THERMAL WEAKENING AND WATER JET IMPACT
Adnan H. Nayfeh *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 349-360 refs (For primary document see N77-10230 01-31)
(Grants NSF GI-39224; NSF ENG-75-20850)
Avail: NTIS HC A16/MF A01

N77-10329*# Miami Univ., Fla.
CALIBRATION AND VERIFICATION OF ENVIRONMENTAL MODELS
Samuel S. Lee, Subrata Sengupta, Norman Weinberg, and Homer Hiser *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1093-1103 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10330*# Joint Inst. for Advancement of Flight Sciences, Washington, D. C.
ON THE ABSORPTION OF SOLAR RADIATION IN A LAYER OF OIL BENEATH A LAYER OF SNOW
Jack C. Larsen and Bruce R. Barkstrom *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1105-1114 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10331*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE INFLUENCE OF THE DIABATIC HEATING IN THE TROPOSPHERE ON THE STRATOSPHERE
Richard E. Turner, Kenneth V. Haggard, and Tsing Chang Chen *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1115-1123 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 04A

N77-10337*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE MAKING OF THE ATMOSPHERE
Joel S. Levine *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1191-1201 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 04A

N77-10340*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A TWO-DIMENSIONAL STRATOSPHERIC MODEL OF THE DISPERSION OF AEROSOLS FROM THE FUEGO VOLCANIC ERUPTION
Ellis E. Remsberg, Carolyn F. Jones (Vought Corp., Hampton, Va.), and Jae Park (Coll. of William and Mary, Williamsburg, Va.) *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1225-1233 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 04A

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N77-10753* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WIND MEASUREMENT SYSTEM Patent
William C. Cliff, Robert M. Huffaker, Werner K. Dahm, James A. L. Thomson (Physical Dyn., Inc., Berkeley, Calif.), Thomas R. Lawrence (LMSC, Huntsville, Ala.), Michael C. Krause (LMSC, Huntsville, Ala.), and David J. Wilson, inventors (to NASA) (LMSC, Huntsville, Ala.) Issued 5 Oct. 1976 5 p Filed 3 Dec. 1975 Supersedes N76-13701 (14 - 04, p 0484)
(NASA-Case-MFS-23362-1; US-Patent-3,984,685; US-Patent-Appl-SN-637268; US-Patent-Class-250-339; US-Patent-Class-250-338; US-Patent-Class-250-347; US-Patent-Class-356-106R) Avail: US Patent Office CSCL 04B

A system for remotely measuring vertical and horizontal winds present in discrete volumes of air at selected locations above the ground is described. A laser beam is optically focused in range by a telescope, and the output beam is conically scanned at an angle about a vertical axis. The backscatter, or reflected light, from the ambient particulates in a volume of air, the focal volume, is detected for shifts in wavelength, and from these, horizontal and vertical wind components are computed.
Official Gazette of the U.S. Patent Office

N77-10754*# Texas A&M Univ., College Station.
A COMPARISON BETWEEN NIMBUS 5 THIR AND ITPR TEMPERATURES AND DERIVED WINDS WITH RAWINSONDE DATA OBTAINED IN THE AVE 2 EXPERIMENT
James E. Arnold, James R. Scoggins, and Henry E. Fuelberg Washington NASA Oct. 1976 83 p refs
(Contract NAS8-26751)
(NASA-CR-2757; M-180) Avail: NTIS HC A05/MF A01 CSCL 04B

During the period of May 11 and 12, 1974, NASA conducted its second Atmospheric Variability Experiment (AVE II) over the eastern United States. In this time interval, two Nimbus 5 orbits crossed the AVE II area, providing a series of ITPR soundings as well as THIR data. Horizontal temperature mapping of the AVE II cloud field is examined using two grid print map scales. Implied cloud top heights are compared with maximum radar-echo top reports. In addition, shelter temperatures in areas of clear sky are compared with the surface temperatures as determined from 11.5 micrometer radiometer data of the THIR experiment. The ITPR sounding accuracy is evaluated using interpolated radiosonde temperatures at times nearly coincident with the ITPR soundings. It was found that mean differences between the two data sets were as small as 1.3 C near 500 mb and as large as 2.9 C near the tropopause. The differences between ITPR and radiosonde temperatures at constant pressure levels were sufficient to induce significant differences in the horizontal temperature gradient. Cross sections of geostrophic wind along the orbital tracks were developed using a thermal wind buildup based on the ITPR temperature data and the radiosonde temperature data. Differences between the radiosonde and ITPR geostrophic winds could be explained on the basis of differences in the ITPR and radiosonde temperature gradients. Author

N77-10755*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE 1976 STANDARD ATMOSPHERE ABOVE 86-km ALTITUDE: RECOMMENDATIONS OF TASK GROUP 2 TO COESA
R. A. Minzner, ed. Washington 1976 77 p refs
(NASA-SP-398) Avail: NTIS HC $4.75 CSCL 04A

The development of an atmospheric model for altitudes above 86 km, is described. Temperature and composition profiles are given particular attention. D.M.L.

N77-10756# Brookhaven National Lab., Upton, N.Y.
AIR MASS MOVEMENTS DETERMINED BY REAL-TIME FRONTAL CHROMATOGRAPHY OF SULFUR HEXAFLUORIDE
R. N. Dietz, E. A. Cote, and R. W. Goodrich 1976 31 p refs Presented at the Symp. on the Development of Nucl.-based Tech., Vienna, 15 Mar. 1976 Sponsored by ERDA
(BNL-20903; Conf-760311-1; SM-206/21) Avail: NTIS HC A03/MF A01

Air samples were obtained for 5 to 30 min using 1-litre evacuated steel bottles equipped with critical orifices and for 5 to 10 h using inert pumps connected to 45-litre Saran bags. With the concentration procedure, one analysis was performed every 10 min. Application to power plant plume chemistry studies by simultaneous determination of SO2, sulfate, and added SF6 showed that the measured decrease of pollutant concentration was primarily attributable to dilution. By continuously passing sampled air through specially treated molecular sieve columns up to 16-ft long, sulfur hexafluoride has been measured with real-time response for as long as 3 1/2 min between backflush periods. The instruments were used in a number of field studies throughout the United States for the quantitative detection of added SF6. Crosswind plume profiles were obtained and air masses were monitored at distances of 100 km during unstable meteorological conditions. ERA

N77-10757# Physics Lab. RVO-TNO, The Hague (Netherlands).
MIE-LIDAR
R. tenKate and C. W. Lamberts Aug. 1975 54 p refs In DUTCH; ENGLISH summary
(PHL-1975-28; TDCK-66715) Avail: NTIS HC A04/MF A01

Backscattering from aerosols was studied both experimentally and theoretically. Using a low power lidar installation, backscattered light can be detected up to a distance of 3 km. The transmission of the homogeneous parts of the atmosphere, for different wavelengths, can be determined from the received signal. The possibilities for determining particle sizes from the backscattering at several wavelengths seems to be restricted to specially shaped particles. This result however is of importance for the evaluation of atmospheric limitations imposed on far-infrared equipment. Author (ESA)

N77-10758# Instituut TNO voor Bouwmaycrialen en Bouwconstructies, Delft (Netherlands).
DETERMINATION OF THE SIMULATION SCALE FROM WIND TUNNEL AND ATMOSPHERE SPECTRA COMPARISONS [BEPALING VAN DE SIMULATIESCHAAL UIT VERGELIJKING VAN WINDTUNNEL- EN ATMOSFEERSPECTRA]
E. Willemsen and P. E. J. Vermeulen Aug. 1975 30 p refs In DUTCH; ENGLISH summary
(BI-75-54) Avail: NTIS HC A03/MF A01

The scale to be used for atmospheric boundary layer simulation was derived from a comparison of wind tunnel and atmospheric power spectra. The atmospheric power spectra of Harris, Davenport, Hino, and Berman are discussed. Using the methods described by these authors, the scale was determined from longitudinal power spectra and the results were compared. The scales were found to be completely different, and calculation of the scale of the atmospheric boundary layer model from the turbulent longitude scale is proposed. ESA

N77-10759# Instituut TNO voor Bouwmaycrialen en Bouwconstructies, Delft (Netherlands).
TURBULENCE MEASUREMENT OF THE SMALL WIND TUNNEL OF IBBC, MAY 1975 [METING VAN DE TURBULENTIESTRUCTUUR IN DE KLEINE WINDTUNNEL VAN HET IBBC, MEI 1975]
P. E. J. Vermeulen Nov. 1975 18 p refs In DUTCH; ENGLISH summary
(BI-75-75) Avail: NTIS HC A02/MF A01

In the context of atmospheric boundary layer wind tunnel simulation, the turbulence of the atmospheric boundary layer was investigated by measuring power spectra, turbulent longitude scales, and coherences. The measuring results are presented and discussed, and the scale of the wind tunnel simulation model was chosen (1 : 750, according to Harris). ESA

N77-10760# National Hurricane and Experimental Meteorology Lab., Boulder, Colo.
RAINFALL ESTIMATION FROM GEOSYNCHRONOUS SATELLITE IMAGERY DURING DAYLIGHT HOURS

Cecilia G. Griffith, William L. Woodley, Stephanie Browner, Jose Teijeiro, Michael Maier, David W. Martin (Wisconsin Univ., Madison), John Stout (Wisconsin Univ. Madison), and Dhirendra N. Sikdar (Wisconsin Univ., Madison) Feb. 1976 122 p refs (PB-254652/1; NOAA-TR-ERL-356; WMPO-7) Avail: NTIS HC A06/MF A01 CSCL 04B

A method to estimate rainfall from visible geosynchronous satellite imagery during daylight hours was derived and tested. Verification tests were performed over two areas in south Florida that differ in size by an order of magnitude. Satellite rain estimates were made and compared to rain volumes measured by a combined system of gages and radar. Two additional tests for which ground truth was available were also made to compare accuracy. GRA

N77-10761# National Weather Service, Salt Lake City, Utah.
USE OF MOS FORECAST PARAMETERS IN TEMPERATURE FORECASTING
John C. Plankinton, Jr. Mar. 1976 11 p refs Sponsored by Nat. Weather Service Forecast Office, Boise, Idaho
(PB-254649/7; NOAA-TM-NWS-WR-106; NOAA-76041304) Avail: NTIS HC A02/MF A01 CSCL 04B

A minimum temperature forecast system for Pocatello, Idaho using the MOS wind and cloud forecasts technique (Model Output Systems) was developed. Overnight minimum temperatures are considered by many forecasters to be strongly related to the following variables: (1) afternoon maximum temperatures; (2) afternoon dew point temperatures; (3) length of night; (4) cloud cover; (5) wind speed and sometimes wind direction; (6) thermal advection; and (7) snow cover or condition of the ground. An existing clear, calm forecast equation which considers points 1, 2, 3, and 7 is presented and adjustments are developed for winds and clouds using the MOS forecasts and finally an adjustment for fog, dew, or frost. GRA

N77-10762# National Weather Service, Salt Lake City, Utah.
FORECASTING THE MONO WIND
Charles P. Ruscha, Jr. Feb. 1976 26 p refs Sponsored by Nat. Weather Service Forecast Office, Seattle
(PB-254650/5; NOAA-TM-NWS-WR-105; NOAA-76041303) Avail: NTIS HC A03/MF A01 CSCL 04B

Foehn-type winds that occur near mountain ranges in the western United States are discussed. Type 1 is the Great Basin high type mono and type 2 is the jet stream mono. These winds usually occur along the Sierra Nevada ranges. A checklist to help forecasters predict an oncoming mono wind is included. The checklist mainly consists of topographic charts that point out the target areas and the conditions under which a mono wind is most probable. GRA

N77-10763# National Environmental Satellite Center, Washington, D.C.
EVALUATION OF A BALANCED 300-mb HEIGHT ANALYSIS AS A REFERENCE LEVEL FOR SATELLITE DERIVED SOUNDINGS
Albert Thomasell Jan. 1976 31 p refs
(PB-253058/2; NOAA-TR-NESS-73; NOAA-76030504) Avail: NTIS HC A03/MF A01 CSCL 04A

A technique is developed and evaluated for using wind observations through application of the balance equation to improve the accuracy of objective height analysis in regions between height observations to provide reliable reference heights for satellite derived soundings. In regions of moderate size, where the height analysis is determined primarily by winds and where the winds are deemed sufficiently dense and accurate, the technique produces interpolated height values with an estimated rms error of 30 m or less 80 to 85 percent of the time. Where these conditions are met it is concluded that the technique provides reliable reference heights. GRA

N77-10764# Texas A&M Univ., College Station. Dept. of Oceanography.
AN ANALYSIS OF DRAG COEFFICIENT AT HURRICANE WINDSPEEDS FROM A NUMERICAL SIMULATION OF DYNAMICAL WATER LEVEL CHANGES IN LAKE OKEECHOBEE, FLORIDA
Robert E. Whitaker, Robert O. Reid, and Andrew C. Vastano Oct. 1975 108 p refs
(Contract DACW72-71-C-0011)
(AD-A023683; CERC-TM-56) Avail: NTIS HC A06/MF A01 CSCL 08/8

A time dependent, two dimensional storm surge algorithm has been used to estimate drag coefficient and the wind speed range. The algorithm represents a vertically integrated physical model which includes nonlinear boundary conditions representing flooding and recession. Wind and water level data were gathered in the Lake Okeechobee region. The lake is a roughly circular feature 60 in diameter with a maximum normal depth of 4 m. The effect of extensively grassed, shallow areas of the lake on wind-driven circulation was simulated by a multilayer canopy flow model and included as a subroutine in the numerical analog. The surge model was calibrated for empirical constants with two seiches and quasi-static wind-induced condition within the lake. Two wind-stress relationships, a quadratic one and the Keulegan-Van Dorn expression, were used to model the air-sea interaction. Multiple surge calculations were performed with a range of drag coefficients. Statistical analyses were made of the difference between the observed and computed water levels for the hurricane of Aug. 1949. The results indicate that the Keulegan-- Van Dorn wind-stress model yields superior results over the windspeed range. This conclusion was verified by a simulation of the surge associated with the hurricane of Oct. 1950. Author

N77-10765# South Dakota Dept. of Natural Resources Development, Pierre. Div. of Weather Modification.
SOUTH DAKOTA WEATHER MODIFICATION PROGRAM RESEARCH COOPERATIVE STUDIES UNDER PROJECT SKYWATER Final Report, 1 Jul. 1975 - 31 May 1976
John A. Donnan, Jackson L. Pellett, and Richard S. Leblang Jun. 1976 199 p refs
(Contract DI-14-06-D-7240)
(PB-254412/0; DWM-76-3) Avail: NTIS HC A09/MF A01 CSCL 04B

An analysis of gridded monthly rainfall data indicates that South Dakota seeded counties received, overall, 6.7% more rainfall during the four program seasons than would be expected on the basis of unseeded county rainfall. A 'Decision Ladder' was developed and found to be useful in streamlining the transfer of weather modification technology to program operations. The Colorado State University Statistics Department used the principal components technique to identify and combine related stations' precipitation time series into a less variable series. North American Weather Consultants found serial rawinsonde data useful in identifying subtle mechanisms governing nocturnal thunderstorm activity. GRA

N77-10766# Naval Environmental Prediction Research Facility, Monterey, Calif.
A TROPICAL CYCLONE ANALOG PROGRAM FOR THE SOUTHWEST PACIFIC OCEAN AND AUSTRALIAN REGION
Samson Brand and Jack W. Blelloch Mar. 1976 23 p refs (AD-A023676; EPRF-TP-1-76) Avail: NTIS HC A02/MF A01 CSCL 04/2

A tropical cyclone analog program for the Southwest Pacific Ocean and Australian areas (SWPAC75) is described. The program is statistical computer technique to provide forecasts of Southwest Pacific Ocean and Australian region tropical cyclones from 12-72 hours. The analog program is discussed in terms of its operational use at Fleet Weather Central, Guam, Mariana Islands. Author (GRA)

N77-10334*# Cornell Univ., New York.
THE NUMERICAL PREDICTION OF TORNADIC WIND-STORMS
Douglas A. Paine and Michael L. Kaplan (Joint Inst. for Advan. of Flight Sci.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1153-1165 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N77-10767*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADAPTATION OF A GENERAL CIRCULATION MODEL TO OCEAN DYNAMICS
Richard E. Turner, Thomas H. Rees, and Gerard E. Woodbury Washington Oct. 1976 40 p refs
(NASA-TN-D-8258; L-10756) Avail: NTIS HC A03/MF A01 CSCL 08C

A primitive-variable general circulation model of the ocean was formulated in which fast external gravity waves are suppressed with rigid-lid surface constraint pressires which also provide a means for simulating the effects of large-scale free-surface topography. The surface pressure method is simpler to apply than the conventional stream function models, and the resulting model can be applied to both global ocean and limited region situations. Strengths and weaknesses of the model are also presented. Author

N77-10768*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
BASELINE DATA ON THE OCEANOGRAPHY OF COOK INLET, ALASKA Final Report, Apr. 1972 - Feb. 1975
Lawrence W. Gatto Feb. 1975 146 p refs
(NASA Order W-13452)
(NASA-CR-149141) Avail: NTIS HC A07/MF A01 CSCL 08C

Regional relationships between river hydrology, sediment transport, circulation and coastal processes were analyzed utilizing aircraft, ERTS-1 and N.O.A.A. -2 and -3 imagery and corroborative ground truth data. The use of satellite and aircraft imagery provides a means of acquiring synoptic information for analyzing the dynamic processes of Cook Inlet in a fashion not previously possible. Author

N77-10769# Hydronautics, Inc., Laurel, Md.
A LABORATORY STUDY OF WIND-WAVE-CURRENT INTERACTIONS, PART 1
Richard S. Scotti Jan. 1975 84 p refs
(Contract N00014-72-C-0509; ARPA Order 1910; NR Proj. 062-472)
(AD-A024002; TR-7211-8-Pt-1) Avail: NTIS HC A05/MF A01 CSCL 08/3

Two series of experiments were performed to study the interactions between both the wind-induced drift layer and the surface wave spectrum and a spatially varying subsurface current field. In the first, measurements were made of the response of the drift layer and surface wave spectrum to an appreciable, but unknown, current gradient. This was accomplished by forcing the current from a 90 cm-deep diffuser section onto a 68.7 cm-deep flat beach. The flow, thereby, experienced a current gradient which diminished to, and remained essentially at, zero a short distance downstream of the beach leading edge. Relaxation times inferred from the data are on the order of 1 to 3 minutes. For the second test series, the beach was set at an angle of 2.65 deg to produce strain rates. Here again, the results indicate that the response of the drift layer lags behind that of the current, as strained by the beach. The measurements of surface wave spectra taken for each of the conditions tested are presently being analyzed in detail; however, some preliminary results are presented. GRA

N77-10770# Naval Oceanographic Office, Washington, D.C.
COASTAL OCEANOGRAPHIC USE OF THE DEFENSE METEOROLOGICAL SATELLITE PROGRAM (DMSP) Final Report
Oscar K. Huh Sep. 1975 43 p refs Revised
(NR Proj. 387-062)
(AD-A024269; NOO-TR-241) Avail: NTIS HC A03/MF A01 CSCL 08/3

The spaceborne infrared sensors (8-13 micrometers) of the Defense Meteorological Satellite Program (DMSP) have provided remarkable images of mesoscale sea surface thermal patterns outlining currents, thermally distinct watermasses, and oceanic fronts. During 1971-72 the thermal outlines of the South Korean Coastal Oceanic Front, the Tsushima Current, the Yellow Sea Warm Current, the China Coastal Current and the Liman Current were detected and monitored with the 2-nmi resolution infrared DMSP imagery. The data are displayed in a series of 16 gray shades on photographlike images covering an area of 1560x3000 nmi of the earth's surface. The images are oblique Mercator projections at scales of 1:15,000,000 or enlarged to 1:7,500,000 with a thermal resolution of 1.6C. The outstanding characteristics of this system are: (1) The high repetition rate of coverage (minimum) of four times daily), (2) near real-time data availability, (3) high-resolution (1/3 and 2 nmi) visual and infrared images, and (4) global coverage. As in other infrared systems, cloud cover prevents sea surface observations. GRA

N77-10771# Naval Oceanographic Office, Washington, D.C.
ASPECTS OF SOUND SPEED STRUCTURE AND RELATED WATER PROPERTIES IN THE GULF OF MEXICO, JUNE - DECEMBER 1969 Final Report
Laurie E. Jarvela and William McComas Oct. 1975 62 p refs
(AD-A024265; NOO-RP-134-18-5) Avail: NTIS HC A04/MF A01 CSCL 08/10

Oceanographic data collected in the Gulf of Mexico during June-December 1969 indicate that the dominant modifier of sound speed structure and related parameters is the East Gulf Loop Current and associated waters. Westerly migration of a detached East Gulf Loop eddy radically altered local sound speed structure in a period as short as one month, while sound speed structure in the eddy remained essentially unchanged during the survey period. Existence of a relic eddy in the western gulf was suggested by temperature-salinity-oxygen relationships. Frequency distributions of sound speed within the thermocline are examined and the existence of two primary sound speed regimes is established. Examples of the effects of the detached eddy on sound ray paths in the thermocline are shown. Use of thermal structure measuring devices to monitor regime movements and to locate their boundaries is discussed. GRA

N77-10772# Naval Research Lab., Washington, D.C.
AMPLITUDE FUNCTIONS AND THE ANALOG OF THE KELVIN WEDGE FOR THREE-DIMENSIONAL INTERNAL WAVES GENERATED BY A MOVING DISTURBANCE Final Report
William B. Heard 23 Apr. 1976 22 p refs
(NRL Proj. B01-10; RR0140241)
(AD-A024452; NRL-7985) Avail: NTIS HC A02/MF A01 CSCL 08/3

Internal waves are generated by a dipole of arbitrary orientation moving on an inclined rectilinear path in a stratified fluid whose Brunt-Vaisala frequency is constant. Expressions for the asymptotic behavior of the phase and the amplitude are obtained by applying the method of Lighthill. The global geometry of the surfaces of constant phase is considered, and there is shown to be an internal wave cone, analogous to the Kelvin wedge for surface waves. Contours of wave amplitude are calculated for different orientations of the dipole, and various sidelobe patterns are found. Author (GRA)

N77-10773# Physical Sciences, Inc., Wakefield, Mass.
MICROSTRUCTURE ANALYSIS. VOLUME 1: THE ORIGIN OF OCEAN FINE STRUCTURE Final Report, 15 Feb. - 15 Aug. 1975
Girard A. Simons 30 Sep. 1975 49 p refs
(Contract N00014-75-C-0927; ARPA Order 2961)
(AD-A024285; PSI-TR-36-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 08/3

The horizontal and vertical length scales of ocean fine structure appear to correlate to the corresponding wavelengths of inertial waves (internal waves whose motion is dominated by Coriolis forces). A priori, there are four possible non-linear mechanisms that could form ocean fine structure from inertial waves: dynamic breaking (shear instabilities), static breaking (inverted density profile), transverse steepening (resonance) and longitudinal steepening (self steepening of waves riding on their own velocity fields). Each mechanism was assessed. Of the four mechanisms proposed, dynamic wave breaking was shown to be the most probable mechanism by which inertial waves form

fine structure. This mechanism is distinct from that of 'billow turbulence' due to an unstable, horizontally propagating gravity wave. An inertial wave is a vertically propagating transverse wave. The transverse velocity field of the wave is a horizontal shear layer and it is the instability of the shear layer that is the proposed source of fine structure. GRA

N77-10774# Scripps Institution of Oceanography, La Jolla, Calif. Advanced Ocean Engineering Lab.
MARINE PHYSICS: INTERNAL WAVES AND MICROSTRUCTURE Technical Progress Report, 1 Jul. - 31 Dec. 1975
Gordon O. Williams, James L. Cairns, and R. Edward Lange 31 Dec. 1975 12 p refs
(Contract N00014-75-C-1034; ARPA Order 2185; NR Proj. 260-105)
(AD-A024287; SIO-REF-76-7) Avail: NTIS HC A02/MF A01 CSCL 08/3

This semi-annual report reflects the technical status of internal wave and microstructure studies conducted at this laboratory. GRA

N77-10775# Hydronautics, Inc., Laurel, Md.
DIRECTIONAL SLOPE AND CURVATURE DISTRIBUTIONS OF WIND WAVES
Jin Wa Jan. 1975 45 p refs
(Contract N00014-72-C-0509; ARPA Order 1910; NR Proj. 062-472)
(AD-A024148; TR-7211-7) Avail: NTIS HC A03/MF A01 CSCL 08/3

The slope and curvature distributions of wind waves along two principal axes (upwind-downwind and crosswind) have been measured in a laboratory tank under various wind velocities. In both directions, the slope distributions are very closely Gaussian, and the components of the mean-square water-surface slope vary logarithmically with the friction velocity of the wind. As the wind velocity increases, the ratio between these two components increases and falls between 0.5 and 0.6 at high wind velocities in the gravity-governing regime of wind-wave interaction. The radius of water-surface curvature, along either direction of measurement, is found to be, generally, greater at a steeper viewing angle from the normal to the mean water surface. The average radius of curvature of the disturbed surface varies inversely with the friction velocity of the wind. The ratio between the upwind-downwind and crosswind components of the average radius of curvature is unity at all wind velocities, indicating that the wind-disturbed water surface is isotropic on the smallest scale. GRA

N77-10332*# Instituto de Mecanica Aplicada y Estructuras, Rosario (Argentina).
USE OF VARIATIONAL METHODS IN THE DETERMINATION OF WIND-DRIVEN OCEAN CIRCULATION
Roberto Gelos (Inst. Argentino de Oceanografia) and Patricio A. A. Laura *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1125-1135 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10333*# Naval Postgraduate School, Monterey, Calif.
OPTICALLY RELEVANT TURBULENCE PARAMETERS IN THE MARINE BOUNDARY LAYER
K. L. Davidson and T. M. Houlihan *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1137-1151 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N77-10776*# Transemantics, Inc., Washington, D.C.
MICROORGANISMS AS PRODUCERS OF HYDROGEN
Ye. N. Kondratyeva and I. N. Gogotov Washington NASA Aug. 1976 38 p refs Transl. into ENGLISH of Izv. Akad., ii Nauk SSSR, Ser. Biol. (USSR), no. 1, Jan. - Feb. 1976 p 69-86
(Contract NASw-2792)
(NASA-TT-F-17131) Avail: NTIS HC A03/MF A01 CSCL 06M

A review is presented of published data on micro-organisms capable of releasing molecular hydrogen, the condition and ways of its formation, the significance of this process, and the possibility of practical applications. Emphasis is placed on the release of hydrogen by chemotrophs such as obligate and faculative anaerobes, and by several species of phototrophs. Most data confirm that photoproduction of hydrogen by green algae is the result of decomposition of endogenic organic substances. The possibility of hydrogen formation is determined by the presence of a specific enzyme called hydrogenase. Author

N77-10777*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
BIOPROCESSING IN SPACE
[1976] 15 p Prepared in cooperation with Boeing Co., Seattle
(Contract NAS9-13655)
(NASA-TM-X-74157) Avail: NTIS HC A02/MF A01 CSCL 06B

Space processing accomplishments onboard Skylab and Apollo Soyuz are reviewed. Possible applications of bioprocessing experiments to be carried on space shuttles and Spacelab are explored. A.H.

N77-10778# Medical Biological Lab. RVO-TNO, Rijswijk (Netherlands).
FIRST RESULTS OF AN INVESTIGATION OF THE EFFECTS OF MICROWAVE RADIATION WITH LOW POWER DENSITY ON THE BEHAVIOR OF RATS [EERSTE RESULTATEN VAN EEN ONDERZOEK NAAR DE EFFECTEN VAN MICROGOLFSTRALING MET LAGE VERMOGENSDICHTHEDEN OP HET GEDRAG VAN RATTEN]
B. Roberti, G. H. Heebels (Lab. for Electron. Develop. of the Armed Forces, Oegstgeest, Neth.), J. C. M. Hendricx (Lab. for Electron. Develop. of the Armed Forces, Oegstgeest, Neth.), and O. L. Wolthuis [1975] 14 p refs In DUTCH; ENGLISH summary
(MBL-1974-15; TDCK-64396) Avail: NTIS HC A02/MF A01

The effect of microwave radiation on the spontaneous motor activity of the male Wistar rat was investigated. Rats were exposed to microwaves of 10.7 GHz, continuous wave (CW), 3 GHz, CW or 3 GHz pulsed wave (PW) with power densities of about 1 mW/sq cm for 185 h. Moreover, a small number of rats was irradiated with 3 GHz, PW at 25 mW/sq cm for 17 days. Spontaneous activity was automatically measured and analyzed in 5 classes of movements of increasing amplitudes. After termination of the irradiation no differences were found between the irradiated rats and the non-irradiated controls. In the experiment with 3 GHz, PW at 25 mW/sq cm for 17 days, rats were used that had been pretrained to a constant top performance on a 2 m long runway. Their running-times were not influenced by the irradiation. No deleterious effects of the microwave irradiation have been found as yet. Author (ESA)

N77-10779# Medical Biological Lab. RVO-TNO, Rijswijk (Netherlands).
THE CONTRACTION PROLONGING ACTION OF 9-ANTHROIC ACID (ANCA) ON THE ISOLATED RAT DIAPHRAGM AND THE EFFECTS OF SOMAN ON THIS PHENOMENON
V. J. Nickolson and F. L. vanVelsen Sep. 1975 45 p refs In DUTCH; ENGLISH summary
(MBL-1975-25; TDCK-66841) Avail: NTIS HC A03/MF A01

The effects of the sodium salt of 9-anthracene carboxylic acid (9-anthroic acid; ANCA) and the cholinesterase inhibitor soman (3,3-dimethyl-2-butyl 2-methyl phosphonofluoridate) on the isolated rat phrenic nerve diaphragm preparation were investigated. Materials and methods used are presented: incubation and stimulation; influence of the stimulation frequency on the contraction prolonging effect of ANCA; direct stimulation; experiments in calcium-free medium; experiments with ouabaine; experiments with different chloride concentrations; and determination of the Na, K, Ca and Mg content. The results of the

determination of the contraction prolonging effect of ANCA are presented and discussed. ESA

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N77-10780* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THERMISTOR HOLDER FOR SKIN TEMPERATURE MEASUREMENTS Patent

John E. Greenleaf and Bill A. Williams, inventors (to NASA) Issued 5 Oct. 1976 4 p Filed 29 Sep. 1975 Supersedes N75-33642 (13 - 24, p 3077)

(NASA-Case-ARC-10855-1; US-Patent-3,983,753; US-Patent-Appl-SN-617612; US-Patent-Class-73-343R; US-Patent-Class-128-2H) Avail: US Patent Office CSCL 06B

An improved thermistor holder structure is disclosed which facilitates skin-temperature measurement. The device includes a cylindrical plastic housing with tab extensions that permits the apparatus to be held to a skin surface by suitable elastic members or the like. Ventilation openings are provided in the plastic housing to permit air circulation. An adjustable, resilient metal arm with a thermistor holding cup formed at one end is secured to the interior surface of the plastic housing such that the holding cup is located at the center of the housing. A thermistor temperature sensor is inserted into and held in the cup by interference fit. Official Gazette of the U.S. Patent Office

N77-10781*+ National Aeronautics and Space Administration, Washington, D.C.

AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 158, SEPTEMBER 1976

Sep. 1976 70 p refs

(NASA-SP-7011(158)) Avail: NTIS HC $4.00 CSCL 06E

This bibliography lists 191 reports, articles, and other documents introduced into the NASA scientific and technical information system in August 1976. Author

N77-10782*# Transemantics, Inc., Washington, D.C.

EXPERIMENTS ABOARD BIOSATELLITES KOSMOS-690 AND KOSMOS-782

Yu. Grigoryev and A. Sedov Washington NASA Sep. 1976 8 p Transl. into ENGLISH from Med. Gazeta (USSR), 9 Apr. 1976 p 3

(NASA-TT-F-17215) Avail: NTIS HC A02/MF A01 CSCL 06R

An artificial source of irradiation was installed aboard the biosatellite Cosmos 690 for simulating the effect of solar flares on white rats. The bioblok microlaboratory was carried aboard the Cosmos 782 satellite. Bioblok consisted of a pair of identical units gathered in a single coordinate system of alternating layers of dielectric track detectors and biological objects enclosed in restraining plates. The experiment was conducted to study the biological effect of heavy ions of galactic cosmic irradiation. The objects used in the experiment were: Brachiopoda subclass eggs, yeast cell colonies, tobacco seeds, and Arabidopsis. Author

N77-10783*# Transemantics, Inc., Washington, D.C.

SECOND EXPEDITION OF THE SALYUT-4 ORBITAL STATION. CERTAIN RESULTS AND TASKS OF MEDICAL RESEARCH

O. G. Gazenko and A. D. Yegorov Washington NASA Oct. 1976 30 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (USSR), no. 4, Apr. 1976 p 25-36

(NASA-TT-F-17223) Avail: NTIS HC A03/MF A01 CSCL 06P

Effects of the Salyut 4 mission on the human organism and other medical problems which remain to be solved are discussed. Research in space medicine is being directed to: (1) perfection of prediction methods of a cosmonaut's possible functional state disorders in long-term flights; (2) further study of adaptation; (3) quantitative evaluation of the role of certain flight factors and the organism's response reactions; and (4) perfection of a method of applying preventive measures and developing new measures. Author

N77-10784# Medical Biological Lab. RVO-TNO, Rijswijk (Netherlands).

MUTAGENICITY TESTING OF SOME NITROFURAN DERIVATIVES AND SOME CHLORINATED HYDROCARBONS

I. E. Mattern Sep. 1975 18 p refs In DUTCH; ENGLISH summary

(MBL-1975-22; TDCK-66737) Avail: NTIS HC A02/MF A01

The mutagenicity of the nitrofuran derivatives nitrofurantoin, nitrofurazone, nifuroxine, 5-nitrofuraldehyde diacetate, and trans-2-(2-furyl)-3-(5-nitro-2-furyl) acrylamide (AF2) and of the chlorinated hydrocarbons pentachlorophenol dieldrin, 2,2'-dichlorodiethylether, trichloroethyl phosphate, and of the two PCB mixtures aroclor 1242 and 1254 was determined using the Ames test, using salmonella typhimurium or Escherichia coli bacteria. In decreasing order of potency 5, 1, 3 and 4 were mutagenic for Escherichia coli. All substances induced base pair substitution mutations. From the chlorohydrocarbons tested only 2,2'-dichlorodiethylether was mutagenic. Also the nitrofuran containing waste water of a pharmaceutical factory was tested and was found to induce mutations, even in a 10,000-fold dilution. ESA

N77-10785# Medical Biological Lab. RVO-TNO, Rijswijk (Netherlands).

THE FUNCTION OF THE GASTROINTESTINAL CHANNEL OF THE RAT DURING SHOCK [DE FUNCTIE VAN HET MAAG-DARMKANAAL VAN DE RAT IN SHOCK]

D. deJong, M. Wijnans, and P. vanEck 1975 29 p refs In DUTCH; ENGLISH summary

(MBL-1975-16; TDCK-66658) Avail: NTIS HC A03/MF A01

The reduction or postponement of shock by drinking salt-containing water was investigated. Rats were bled and by means of I-131 polyvinylpyrrolidon (PVP), which is little resorbed in the gastrointestinal channel, the influence of shock on transport from the stomach was established. The experiment was repeated with a labeled 0.9% NaCl solution. Results were compared with those of non-shocked animals. In severely shocked rats the salt fluid administered was retained to a considerable degree in the stomach, apparently due to atonia of the stomach wall. There also appeared to be atonia of the intestinal wall. ESA

N77-10786# Cleveland Clinic Foundation, Ohio. Dept. of Artificial Organs.

BIOLIZED LATEX POLYURETHANES Annual Report, 1 Dec. 1974 - 30 Nov. 1975

Y. Nose, G. Picha, H. Kambic, D. F. Gibbons, and R. Martin Mar. 1976 43 p refs

(Contract N01-HB-3-2914)

(PB-253085/5; NIH-N01-HB-3-2914-3) Avail: NTIS HC A03/MF A01 CSCL 06L

The potential use of latex polyurethanes (LPU) in the development of biolized materials was evaluated. Nine LPU's, including both polyester and polyether types, were studied in addition to Biomer as a control. The pure polymers, unbiolized, were optimized with respect to curing time and temperature. The initial areas of development of the LPU's were processing, mechanical performance, tensile properties, as determined, hydrolysis, histocompatibility, and hemocompatibility. The latex urethanes have been preliminarily screened, evaluated for feasibility, and are still in the process of being optimized. Six materials have been eliminated from the study while the three LPU's still under investigation were found capable of withstanding severe hydrolytic environment up to 15 days. Biolization was not found to significantly alter the histopathological response which seems to be controlled by the LPU. However, the LPU's, as tested in the in vitro closed kinetic test cell, showed better performance than the Silastic control and all biolized LPU's showed significant improvement over the nonbiolized LPU's. GRA

N77-10787# Calspan Corp., Buffalo, N.Y.

INTERFACIAL BIOPHYSICS OF MATERIALS IN CONTACT WITH BLOOD Annual Report, 16 Jan. 1975 - 15 Jan. 1976

R. E. Baier, C. Akers, S. Perlmutter, V. L. Gott (Johns Hopkins

Univ., Baltimore), and J. ORiordan (Johns Hopkins Univ., Baltimore) 1 Mar. 1976 110 p
(Contract HB-3-2953)
(PB-253117/6; CALSPAN-W06-EB-5307-M-18; NIH/NHLI-N01-HB-3-2953-2) Avail: NTIS HC A06/MF A01 CSCL 06L

The nature, sequence and severity of early adsorptive and cellular adhesive events were established at the boundary between blood and nonphysiologic materials proposed for blood contact applications in a variety of medically useful devices. Task 1 involves the production and analysis of interfacial layers of proteins and polypeptides. Task 2 is devoted to the in vivo evaluation of competing concepts of thromboresistance, mainly investigating low surface-free-energy and high surface-free-energy materials in the canine vena cava ring test. Task 3 provides for characterization of the surface properties of biocompatible materials from 12 separate sources. GRA

N77-10788# General Electric Co., Schenectady, N.Y. Research and Development Center.
DEVELOPMENT AND EVALUATION OF AN ULTRASONIC IMAGING SYSTEM Annual Report, 15 Jun. 1975 - 15 Mar. 1976
Paul M. Griffen, Henry A. F. Rocha, Charles E. Thomas, and John R. M. Viertl 31 Mar. 1976 84 p refs
(PB-252561/6; SRD-76-035; NIH/NHLI-N01-HV-5-2966-1) Avail: NTIS HC A05/MF A01 CSCL 06L

Detection and characterization of atheroma requires much higher resolution than available in current ultrasonic imaging systems. The purpose was to implement laser shock excitation techniques for wideband acoustic generation and optimized electrostatic receivers for wideband acoustic detection. It was shown that very short acoustic pulses can be generated having useful energy in the 2 MHz to 20 MHz range. Electrostatic receivers were fabricated and tested which are as sensitive as a PZT crystal at or near their tuned frequency. Evaluation of a coupled laser shock excitation acoustic generator and an electrostatic receiver indicated that the useful acoustic range was 1 to 50 MHz. Iterative improvements are continuing. GRA

N77-10789# Michigan State Univ., East Lansing. Div. of Engineering Research.
INDUCED EM FIELD AND ABSORBED POWER DENSITY INSIDE HUMAN TORSOS BY 1 TO 500 MHz EM WAVES
Kun-Mu Chen and B. S. Guru Apr. 1976 184 p refs
(Grant NSF ENG-74-12603)
(PB-254247/0; TR-1) Avail: NTIS HC A09/MF A01 CSCL 06R

Numerical results on the internal EM field and absorbed power density inside a human torso induced by EM waves of frequencies ranging from 1 to 500 MHz and of both vertical and horizontal polarizations are presented. GRA

N77-10241*# Connecticut Univ., Storrs.
THEORY OF ORTHODONTIC MOTIONS
Susan Pepe, W. Dennis Pepe (Conn. General Insurance Co.), and Alvin M. Strauss (Cincinnati Univ.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 103-110 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10260*# Cincinnati Univ., Ohio.
BIODYNAMICS OF DEFORMABLE HUMAN BODY MOTION
Alvin M. Strauss and Ronald L. Huston *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 309-318 refs (For primary document see N77-10230 01-31)
(Grants NSF ENG-75-21037; NSF ENG-75-06619)
Avail: NTIS HC A16/MF A01

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N77-10790*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUBJECTIVE RESPONSE TO COMBINED NOISE AND VIBRATION DURING FLIGHT OF A LARGE TWIN-JET AIRPLANE
Sherman A. Clevenson Washington Oct. 1976 43 p refs
(NASA-TM-X-3406; L-10578) Avail: NTIS HC A03/MF A01 CSCL 05H

A NASA twin-jet airplane was used to obtain controlled noise and vibration environments during flight while obtaining subjective responses from 13 passenger-subjects (6 females and 7 males). Subjective ratings of overall comfort, comfort when considering only vibration, and comfort when considering only noise were obtained during times of different vibration and noise environments. Passenger-subjects were able to distinguish and rate noise better than vibration. In addition, there was a statistically significant difference in ratings of ride comfort due to both sex type and flight experience. Males rated flying discomfort much more severely than females when rating the overall ride and the ride when considering only the noise environment. Experienced passengers also rated the overall ride to be more uncomfortable than inexperienced passengers. Author

N77-10791*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NOISE AND VIBRATION RIDE COMFORT CRITERIA
Thomas K. Dempsey, Jack D. Leatherwood, and Sherman A. Clevenson Oct. 1976 25 p refs Presented at the 92d Acoustical Soc. of Am. Meeting, San Diego, Calif., 16-19 Nov. 1976
(NASA-TM-X-73975) Avail: NTIS HC A02/MF A01 CSCL 05H

Two of the most important factors, namely, vibration and noise, were studied to (1) determine whether composite or separate noise and vibration criteria are needed for the prediction of ride quality, (2) determine a noise correction for the previously-defined vibration criteria of the ride quality model, (3) assess whether these noise corrections depend on the nature of the vibration stimuli, i.e., deterministic as opposed to random, and (4) specify noise-vibration criteria for this combined environment. The stimuli for the study consisted of octave bands of noise centered at 500 or 2,000 Hz and vertical vibrations composed of either 5 Hz sinusoidal vibration or random vibrations centered at 5 Hz and with a 5 Hz bandwidth. The noise stimuli were presented at levels ranging from ambient to 95 dB(A) and the vibrations at levels ranging from 0.02 to 0.13g rms. Author

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N77-10792*# Minnesota Univ., St Paul. Dept. of Food Science and Nutrition.
STORAGE STABILITY AND IMPROVEMENT OF INTERMEDIATE MOISTURE FOODS, PHASE 3 Final Report, Aug. 1974 - Aug. 1975
T. P. Labuza 1975 386 p refs
(Contract NAS9-12560)
(NASA-CR-151004) Avail: NTIS HC A17/MF A01 CSCL 06H

Methods were determined for the improvement of shelf-life stability of intermediate moisture foods (IMF). Microbial challenge studies showed that protection against molds and Staphylococcus aureus could be achieved by a combination of antimicrobial agents, humectants and food acids. Potassium sorbate and propylene glycol gave the best results. It was also confirmed that the maximum in heat resistance shown by vegetative pathogens at intermediate water activities also cocurred in a solid food. Glycols and sorbitol both achieve browning inhibition because of their action as a medium for reaction and effect on viscosity of the adsorbed phase. Chemical availability results showed rapid lysine loss before visual discoloration occurred. This is being confirmed with a biological test using Tetrahymena

pyriformis W. Accelerated temperature tests show that effectiveness of food antioxidants against rancidity development can be predicted; however, the protection factor changes with temperature. BHA was found to be the best antioxidant for iron catalyzed oxidation. Author

N77-10793*# Decision Science, Inc., San Diego, Calif.
A COMPUTER PROGRAM FOR THE USE OF SENSITIVITY ANALYSIS IN DISPLAY EVALUATION
Michael L. Mout and George H. Burgin 1976 72 p refs
(Contract NAS1-13734)
(NASA-CR-145060) Avail: NTIS HC A04/MF A01 CSCL 05E

A description is provided of the Display Evaluation computer program, some results of this program and comparison of these results with a simple experiment. A detailed description of the experiment and data analysis are also included. Author

N77-10794# Aerojet Nuclear Co., Idaho Falls, Idaho.
HUMAN FACTORS IN DESIGN
M. G. Bullock and R. J. Nertney Feb. 1976 138 p
(Contract E(10-1)-1375)
(ERDA-76-45) Avail: NTIS HC A07/MF A01

Human factors is a subject which is becoming of greater importance to the equipment designer. One reason is the increasing need for high reliability systems. Total reliability is dependent upon both the basic hardware reliability built into the design and the way that the human operator manipulates and uses the equipment. It is pointed out that a higher degree of responsibility for use and misuse implies that human factors are of more importance in the commercial design processes now than in the days when liability was more completely limited to product mechanical defects. This, in turn, means that the contemporary design engineer must have a greater knowledge of human factors than has been required in the past if he is to keep pace with the times. Author (ERA)

N77-10795# Kaman Sciences Corp., Colorado Springs, Colo.
A SOLID STATE DIGITAL DATA RECORDER FOR MONITORING ANTHROPOMORPHIC DUMMY IMPACT ENVIRONMENTS Final Report
Randolph J. Wolf May 1976 73 p refs
(Contract DOT-HS-4-00927)
(PB-254036/7; K-76-28U(R); DOT-HS-801-907) Avail: NTIS HC A04/MF A01 CSCL 13L

A solid state digital data recorder was developed for use in monitoring anthropomorphic dummy impact environments. The recorder was designed to be a very general miniature data acquisition system and was mounted in the pelvic assembly of a 50th percentile anthropomorphic dummy. An eight channel system was evaluated in a sled test series simulating a 30 mph vehicle-barrier impact. The dummy/recorder system was also evaluated in five vehicle collisions. During these tests the system successfully captured and stored impact information on all thirteen collisions in which it participated. GRA

N77-10796# National Inst. for Occupational Safety and Health, Morgantown, W.Va. Testing and Certification Lab.
DETERMINATION OF FACEPLATE CARBON-DIOXIDE CONCENTRATION LEVELS OF SELF-CONTAINED BREATHING APPARATUS
Samuel L. Terry Nov. 1975 24 p refs
(PB-252695/2; NIOSH/TC/R-003) Avail: NTIS HC A02/MF A01 CSCL 06K

While an individual is wearing a self-contained breathing apparatus, he is exposed to various concentration levels of expired carbon dioxide. These levels adversely affect the user's behavior and the respirators performance. Because of the variability among test subjects, this procedure has been standardized to a machine-test method using a breathing machine with a sedentary cam which operates at 14.5 respirations per minute with a minute volume of 10.5 liters. A 5% air carbon dioxide mixture is fed into the facepiece during exhalation and the average exposure level during inhalation is calculated. Experimental design limits this method to breathing apparatus with less than 1100 cc of effective dead-air space. The standard deviation of CO2 concentrations obtained by this method is less than 0.1% CO2 at a 95% confidence level. GRA

N77-10797# National Inst. for Occupational Safety and Health, Morgantown, W.Va. Testing and Certification Lab.
PROCEDURE FOR CONTINUOUS-FLOW RESPIRATOR FLOWRATE DETERMINATION
Steven W. Lenhart Nov. 1975 20 p refs
(PB-252694/5; NIOSH/TC/R-004) Avail: NTIS HC A02/MF A01 CSCL 06K

The test procedure was prepared as a guide to a method of determining the volume of air delivered by a continuous flow supplied-air respirator. The method has the advantage that the test results can be documented on recorder paper. The respiratory inlet covering of a supplied-air system is placed in a container with an outlet; the outlet of the container is connected to a pneumotachometer and pressure transducer. Flow rates delivered by the respiratory inlet covering at specified pressures and air supply hose lengths are recorded and determined from a graph prepared during pneumotachometer calibration. GRA

N77-10798# National Inst. for Occupational Safety and Health, Morgantown, W.Va. Testing and Certification.
PROCEDURE FOR TESTING STRENGTH OF HOSE AND COUPLINGS
Steven W. Lenhart Feb. 1976 18 p ref
(PB-252696/0; NIOSH/TC/R-006) Avail: NTIS HC A02/MF A01 CSCL 06K

A procedure was developed for testing the strength of hose and couplings of supplied air respirators. Hose and couplings used with Types A, AE, B, and BE respirators are tested with a pull of 113 kilograms for five minutes. Hose and couplings used with Types C and CE respirators are tested with a pull of 45 kilograms for five minutes and also subjected to an internal air pressure. GRA

N77-10380*# Cincinnati Univ., Ohio.
EXPERIMENT DESIGN FOR PILOT IDENTIFICATION IN COMPENSATORY TRACKING TASKS
William R. Wells *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1721-1731 refs (For primary document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

N77-10799*# Joint Publications Research Service, Arlington, Va.
ON THE POSSIBLE UNIQUENESS OF INTELLIGENT LIFE IN THE UNIVERSE
I. S. Shklovskiy Washington NASA Oct. 1976 19 p Transl. into ENGLISH of Report PR-262, Academy of Sciences USSR, Inst. of Space Res., Moscow, 1976 p 1-30
(NASA Order W-13183)
(NASA-TT-F-17247) Avail: NTIS HC A02/MF A01 CSCL 03C

The modern conception of an expanding universe rejects theories of cosmic wonders, transformation of matter, or superintelligent cosmic factors as sources of intelligent life on earth. Life emerged on earth and became intelligent as the result of an extremely rare combination of improbable circumstances. The expansion of intelligent life in the universe will be accomplished by the establishment of artificial biospheres orbiting the moon or stationed in galaxies. Communications between these space colonies will rely on computer technology and radio astronomy. A.H.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering*.

N77-10800# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
OUTLINE OF A DATA BANK SYSTEM FOR NATIONAL AND REGIONAL PLANNING
K. Hahne, H. Welscheid, and M. C Pistorius Sep. 1975 88 p refs
(CSIR-WISK-181; ISBN-0-7988-0764-4) Avail: NTIS HC A05/MF A01

Nine information systems for urban or regional planning in five European countries and the United States were studied. An analysis was made of output types and programs, available and desired data, user interface to the system, and the protection of data against abuse and damage. A model is presented for a national and regional planning system. A.H.

N77-10801*# Tennessee Univ., Knoxville. Electrical Engineering Dept.
ARCHITECTURE AND DATA PROCESSING ALTERNATIVES FOR THE tse COMPUTER. VOLUME 4: IMAGE ROTATION USING tse OPERATIONS Final Report, May 1974 - Aug. 1976
Min-Hwan Kao and Robert E. Bodenheimer Oct. 1976 134 p refs
(Grant NsG-5002)
(NASA-CR-149105; TR-EE/CS-76-4-Vol-4; TN-37916) Avail: NTIS HC A07/MF A01 CSCL 09B

The tse computer's capability of achieving image congruence between temporal and multiple images with misregistration due to rotational differences is reported. The coordinate transformations are obtained and a general algorithms is devised to perform image rotation using tse operations very efficiently. The details of this algorithm as well as its theoretical implications are presented. Step by step procedures of image registration are described in detail. Numerous examples are also employed to demonstrate the correctness and the effectiveness of the algorithms and conclusions and recommendations are made.
Author

N77-10802*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INTERFACE BETWEEN A DATAMETRICS 1085A MANOMETER AND A HEWLETT-PACKARD 2100S COMPUTER
Mervin E. Hiilard, Jr. and James I. Clemmons 13 Sep. 1976 24 p refs
(NASA-TM-X-73976) Avail: NTIS HC A02/MF A01 CSCL 09B

A hardware/software interface designed to mate a Datametrics models 1085A electronic manometer to a Hewlett-Packard (HP) model 2100S computer is described. The software driver operates in the basic control system (BCS) and requires 173 words of memory; the hardware interface uses an HP data source interface (DSI) card which requires one computer input/output channel. Results obtained by incorporating this interface into a data acquisition system indicate that the interface operates successfully. Author

N77-10803# California Univ., Berkeley. Lawrence Berkeley Lab.
DIGITIZING HIGH FREQUENCY SIGNALS USING SERIAL ANALOG MEMORIES
J. W. Coonrod Oct. 1975 22 p refs
(Contract W-7405-eng-48)
(LBL-4468) Avail: NTIS HC A02/MF A01

An online computer system has been developed as a replacement for oscilloscopes and cameras on the Tormac project. Up to 32 simultaneous waveforms are recorded at up to 2 MHz in analog shift registers, then digitized sequentially after the event into a small PDP-11 computer. Data and functions of data may be displayed or plotted locally, and then forwarded for storage at a larger, remote computer via a network arrangement. Advantages over scopes have been lower incremented cost, less noise pickup, better resolution (less than 1%), and immediate presentation of data. ERA

N77-10804# National Bureau of Standards, Washington, D.C. Inst. for Computer Sciences and Technology.
PROCEEDINGS OF THE 11TH COMPUTER PERFORMANCE EVALUATION USERS GROUP (CPEUG)
Harold J. Highland Sep. 1975 217 p refs Held at Oklahoma City, 23-26 Sep. 1975
(PB-252174/8) Avail: NTIS HC A10/MF A01 CSCL 09B

Papers presented at the Eleventh Meeting of the Computer Performance Evaluation Users Group (CPEUG) are included. GRA

N77-10805# Michigan Univ., Ann Arbor. Graduate School of Business Administration.
TOWARDS THE DEVELOPMENT OF PRIMITIVES FOR DATA BASE PROCEDURES TRANSLATION Interim Report, 1 Jul. 1974 - 30 Jun. 1975
Steve Schindler and Eric Kintzer Jun. 1975 37 p refs
(Contract DCA100-72-C-0019; ORA Proj. 011067)
(AD-A023842; Working-Paper-901) Avail: NTIS HC A03/MF A01 CSCL 09/2

There is a significant problem of translating data and software across computer systems. When data is translated across systems it is likely to be changed in format and/or structure to conform to the new environment. This change may significantly complicate the process of translating the applications software that operates on the data. This paper discusses the concept of producing equivalent data base procedure operation to facilitate applications software translation. GRA

N77-10806# Mitre Corp., Bedford, Mass.
COMMUNICATIONS PROCESSORS: CATEGORIES, APPLICATIONS, AND TRENDS
K. T. Mahoney Mar. 1976 56 p refs
(Contract F19628-75-C-0001; AF Proj. 572E)
(AD-A023692; MTR-3102; ESD-TR-75-371) Avail: NTIS HC A04/MF A01 CSCL 09/2

Communication processor applications are expanding as the trend continues towards distributed processing in information systems. This report identifies and describes the major categories of communications processors. As an example of current applications, the use of communications processors within existing systems is detailed. The potential impact of emerging technologies on the design and use of communications processors is discussed. Tradeoffs and guidelines in selecting a device for a specific application are included, with manufacturer models presented as illustrations. Author (GRA)

N77-10807# Naval Postgraduate School, Monterey, Calif.
MICROPROGRAMMABLE INTEGRATED DATA ACQUISITION SYSTEM-FATIGUE LIFE DATA APPLICATION M.S. Thesis
Wesley Craig Stanfield Mar. 1976 60 p refs
(AD-A024592) Avail: NTIS HC A04/MF A01 CSCL 09/2

The 'Microprogrammable Integrated Data Acquisition System-Fatigue Life Data Application' (Midas FLD) is a microprocessor based data acquisition system. It incorporates a Pro-Log Corporation MPS 803 microprocessor, Microvox wafer recorder and various integrated circuit devices to process analog signals. The program written for the MPS 803 is dedicated to processing and recording in sequence aircraft fatigue data originating from strain gages located at fatigue critical points. This thesis describes

the various modules of the system and details the development process used in constructing Midas FLD, including the application of the PLM compiler, Intellec 8 development computer and associated testers. Appendix II gives detailed instructions for reconstructing Midas FLD. GRA

N77-10098*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE 512-CHANNEL CORRELATOR CONTROLLER
S. S. Brokl *In its* The Deep Space Network 15 Oct. 1976 p 34-41 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 09B

N77-10303*# Michigan Univ., Ann Arbor.
TOOLS FOR COMPUTER GRAPHICS APPLICATIONS
R. L. Phillips *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 791-803 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N77-10808*# SDC/Integrated Services, Inc., Slidell, La.
U1108 PERFORMANCE MODEL
G. Trachta 17 Jun. 1976 63 p
(Contract NAS8-31642)
(NASA-CR-150022; SDC/ISI-236/001) Avail: NTIS HC A04/MF A01 CSCL 09B

A model of Univac 1108 work flow has been developed to assist in performance evaluation studies and configuration planning. Workload profiles and system configurations are parameterized for ease of experimental modification. Outputs include capacity estimates and performance evaluation functions. The U1108 system is conceptualized as a service network; classical queueing theory is used to evaluate network dynamics. Author

N77-10809*# Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
CODE USAGE ANALYSIS SYSTEM (CUAS)
P. H. Horsley and J. D. Oliver Sep. 1976 203 p Revised
(Contract NAS9-12200)
(NASA-CR-151031; LEC-8119-Rev-1; JSC-10917-Rev-1) Avail: NTIS HC A10/MF A01 CSCL 09B

A set of computer programs is offered to aid a user in evaluating performance of an application program. The system provides reports of subroutine usage, program errors, and segment loading which occurred during the execution of an application program. It is presented in support of the development and validation of the space vehicle dynamics project. Author

N77-10810*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GASPLOT: A COMPUTER PROGRAM FOR RAPID PRODUCTION OF THERMOPHYSICAL PROPERTIES CHARTS FOR CYCLE ANALYSIS AND PROPERTY EVALUATIONS
R. C. Hendricks and R. J. Trivisonno 1976 23 p refs Proposed for presentation at Winter Ann. Meeting of the Am. Soc. of Mechanical Engineers, New York, 5-10 Dec. 1976
(NASA-TM-X-71915; E-8707) Avail: NTIS HC A02/MF A01

GASPLOT is a FORTRAN 5 computer program which slaves a CALCOMP plotter to produce a variety of accurate thermophysical properties charts. The ordinate-abscissa pair may be any two of pressure, temperature, density, enthalpy, entropy, specific heat, sonic velocity, thermal conductivity, viscosity, or surface tension. The parameters may be temperature, pressure, density, entropy or enthalpy. A special feature of this program is the ability to produce a chart which amplifies (or reduces) a given chart to achieve the desired resolution. Author

N77-10811# Sandia Labs., Albuquerque, N.Mex.
THREEDY DIFFERENCE METHOD
D. L. Hicks, H. S. Lauson, and M. M. Madsen Jan. 1976 37 p refs
(Contract AT(29-1)-789)
(SAND-75-0578) Avail: NTIS HC A03/MF A01

THREEDY is a three dimensional wave propagation code which employs operator splitting. The difference method in THREEDY is described. Author (ERA)

N77-10812# Systems Science and Software, La Jolla, Calif.
COMPUTER MODELING OF COAL GASIFICATION REACTORS Quarterly Technical Progress Report, 30 Jun. - 30 Sep. 1975
15 Oct. 1975 31 p refs
(Contract E(49-18)-1770)
(FE-1770-4) Avail: NTIS HC A03/MF A01

The FLUB code is a finite difference, numerical formulation of the unsteady one-dimensional equations describing chemically inert, gas fluidized bed dynamics. These equations, developed within the framework of the theory of interacting continua, express mass and momentum conservation for both the solid particles and the gas phase of a fluidized bed. The FLUB code was extended to include the balance equations for chemical species transport and the principle of conservation of energy in both solid and gaseous phases. The differential equations for solid particle-gaseous phase flow are briefly presented. To this system of equations, the balance equations for chemical species in the fluidized bed are adjoined. The corresponding difference equations for species transport are then derived. This difference scheme, presently used in FLUB, is based upon well-established numerical methods. Advanced developments are outlined. Author (ERA)

N77-10813# California Univ., Livermore. Lawrence Livermore Lab.
VELOCITY DAMPING IN THE HEMP COMPUTER PROGRAM
D. M. Norris and D. F. Quinones 20 Jan. 1976 21 p refs
(Contract W-7405-eng-48)
(UCID-17009) Avail: NTIS HC A02/MF A01

A velocity damping option in the HEMP explicit finite difference computer program for static problems was investigated and compared with an implicit finite element calculation for the case of elastic-plastic material. The calculations show equal accuracy and demonstrate the effectiveness and the limitations of the damping scheme used with the dynamic HEMP program. Timing studies indicate that the explicit finite difference formulation is efficient when compared to one well-known implicit finite element program even for static calculations. ERA

N77-10814# Oak Ridge National Lab., Tenn.
AMP (ACTIVITY MANIPULATION PROGRAM)
W. W. Engle, Jr. Mar. 1976 13 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5296) Avail: NTIS HC A02/MF A01

AMP is a FORTRAN 4 program written to handle energy group structured activity factors such as sources, conversion factors, and response functions, as used by ANISN, DOT III, and other nuclear reactor and shielding codes. Activities may be retrieved from ANISN type cross section and activity sets found on cards and tapes, and from tabular type sets on cards. They may be altered by change of group structure, multiplication by a constant, or multiplication by delta E (the group-energy interval), and then output to ANISN type cards or tape and tabular type cards. A full edit of input and output activities is always printed by group and activity number. ERA

N77-10815# California Univ., Livermore. Lawrence Livermore Lab.
QUALITY SOFTWARE FOR ORDINARY DIFFERENTIAL EQUATIONS AT LLL
A. C. Hindmarsh Feb. 1976 6 p refs Presented at the 80th National Meeting of Am. Inst. of Chem. Engr., Boston, 7-10 Sep. 1975
(Contract W-7405-eng-48)
(UCRL-76671-Rev-1; Conf-750902-11) Avail: NTIS HC A02/MF A01

Work in the area of ordinary differential equations (initial value problem) is briefly discussed. The work was motivated by such problems as the study of chemical kinetics systems and

the treatment of systems of partial differential equations (such as arise in atmospheric models) by the method of lines. Aspects of the codes GEAR, EPISODE, GEARB, EPISODEB, and block-SOR are presented. ERA

N77-10816# California Univ., Livermore. Lawrence Livermore Lab.

DEVELOPMENT OF DESIGN AUTOMATION CODES USING SOFTWARE ENGINEERING METHODS

R. J. Smith, II 31 Oct. 1976 8 p Presented at the 9th Ann. Asilomar Conf. on Circuits, Systems and Computers, Pacific Grove, Calif., 3-5 Nov. 1975 Revised

(Contract W-7405-eng-48)

(UCRL-77279-Rev-1; Conf-751109-9) Avail: NTIS HC A02/MF A01

The formation of a design automation group, responsible for development of new design automation capabilities, is discussed. The environment in which the software is being produced, and methodologies employed by the development team, are outlined. Author (ERA)

N77-10817# Energy Research and Development Administration, Washington, D.C.

BLOCK TRANSFERS IN CAMAC SYSTEMS

Feb. 1976 13 p refs

(TID-26616) Avail: NTIS HC A02/MF A01

A wide variety of block transfer algorithms (or modes) are possible in computer automated measurement control(CAMAC) systems. However, a restricted number of such algorithms can satisfy nearly all needs. Recommended algorithms are presented to encourage uniformity in design of CAMAC modules and controllers with resulting increased compatibility. ERA

N77-10818# Naval Postgraduate School, Monterey, Calif.

A NUMERICAL COMPARISON OF TOEPLITZ EQUATION SOLVING ALGORITHMS Final Report, Jul. 1975 - Apr. 1976

Edison L. Bell and Richard Franke Apr. 1976 17 p refs

(AD-A024059; NPS-53F76041) Avail: NTIS HC A02/MF A01 CSCL 09/4

This report presents the results of a test of the numerical accuracy of some Toeplitz equation-solving algorithms. A typical autocorrelation function of signal plus noise was used to form the Toeplitz coefficient matrix. Thirty separate data sets of systems of order 4 through 128 were formed, and the resulting equations were solved by each of four different algorithms. IMSL's LEQT1F Gauss elimination procedure, run in double precision, was used as the standard for comparison of accuracies. The results show that the Levinson algorithm is to be recommended for small (order - 16) systems to which it is applicable. Otherwise, the algorithm of choice is the Bareiss algorithm. Author (GRA)

N77-10819# Naval Surface Weapons Center, White Oak, Md.

FIELD DATA REDUCTION SOFTWARE FOR UNIVAC AN/UYK-15 AND UNIVAC 1616 COMPUTERS: DESCRIPTION AND USER'S MANUAL Final Report

M. L. Warner and E. G. Jacques 19 Nov. 1975 73 p

(AD-A023463; NSWC/WOL/TR-75-68) Avail: NTIS HC A04/MF A01 CSCL 09/2

This software package describes a system that is used to gather and reduce a large amount of field test data. The method used to reduce the data onto a single 9-track magnetic tape is first described. Then a method is described to transform the reduced data into data that can be easily used by the engineers and scientists on the project. GRA

N77-10820# Texas Univ., Austin. Center for Cybernetic Studies.

PAGE CUTS FOR INTEGER INTERVAL LINEAR PROGRAMMING

R. Armstrong, A. Charnes, and F. Phillips Nov. 1975 24 p refs

(Contracts N00014-75-C-0569; N00014-75-C-0616; NR Proj. 047-021)

(AD-A022689; CCS-199) Avail: NTIS HC A02/MF A01 CSCL 12/1

In this paper a cutting plane algorithm is developed to solve Integer Interval Linear Programming (IILPs). As in other cutting plane algorithms the integer restrictions are dropped first and the resulting interval programming problem is solved. The cuts which are constructed are valid cuts since an optimal noninteger solution will be eliminated but all feasible integer solutions will satisfy the cut constraint. GRA

N77-10821# Wisconsin Univ., Madison. Mathematics Research Center.

A SUBGRADIENT ALGORITHM FOR SOLVING K-CONVEX INEQUALITIES

Stephen M. Robinson Jan. 1976 12 p refs

(Contract DAAG29-75-C-0024; Grant NSF DCR-74-20584)

(AD-A022720; MRC-TSR-1610) Avail: NTIS HC A02/MF A01 CSCL 12/1

An algorithm is presented for solving a system of K-convex inequalities. The method requires the computation of a subgradient of the system at each iteration, but differentiability is not required. Global convergence, at least linear and sometimes quadratic, is shown to hold if the inequalities are regular. Author (GRA)

N77-10822# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.

FAST ALGORITHMS FOR MANIPULATING FORMAL POWER SERIES Interim Report

H. T. Kung and R. P. Brent (Australian Natl. Univ.) Jan. 1976 44 p refs

(Contract N00014-76-C-0370; Grant NSF MCS-75-22255; NR Proj. 044-422)

(AD-A022987) Avail: NTIS HC A03/MF A01 CSCL 12/1

The classical algorithms require O(n sup 3) operations to compute the first n terms in the reversion of a power series or the composition of two series, and O((n sup 2) log n) operations if the fast Fourier transform is used for power series multiplication. In this paper we show that the composition and reversion problems are equivalent (up to constant factors), and we give algorithms which require only O((n log n) sup 3/2) operations. In many cases of practical importance only O(n log n) operations are required. An application to root-finding methods which use inverse interpolation is described, some results on multivariate power series are stated, and several open questions are mentioned. GRA

N77-10823# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

METHODOLOGY FOR THE EFFECTIVE TEST CASE SELECTION, PHASE 3 Final Report

William Howden and Leon G. Stucki Mar. 1976 123 p refs (Contract C-5-35933)

(PB-254276/9; MDC-G6211; NBS-GCR-76-69) Avail: NTIS HC A06/MF A01 CSCL 09B

The problem of providing automated assistance in the selection and construction of meaningful test cases for computer applications programs is considered. Key issues involve the identification of criteria for grouping together similar program paths, and a means of reducing the number of paths through a program which need to be analyzed to ensure correctness. The investigation has lead to design of a general methodology addressing this problem. Phase III of this research has resulted in the completion of a prototype software testing tool called DISSECT. DISSECT provides capabilities ot analyze FORTRAN program paths and to symbolically evaluate the potential executive results. GRA

N77-10824# Army Concepts Analysis Agency, Bethesda, Md.

A COMPUTER PROGRAM FOR FITTING PROGRESSIVELY CENSORED SAMPLES TO A NORMAL OR LOGNORMAL DISTRIBUTION (CENSNORM) Documentation Report

Richard A. Robinson Mar. 1976 62 p

(AD-A023932; CAA-D-76-1) Avail: NTIS HC A04/MF A01 CSCL 09/2

The CENSNORM is a UNIVAC 1108 computer program for fitting progressively censored samples to a normal or lognormal distribution. Maximum-likelihood estimating equations are used to calculate the distribution parameters. Author (GRA)

N77-10825# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

THE FOREMAN: PROVIDING THE PROGRAM EXECUTION

ENVIRONMENT FOR THE NATIONAL SOFTWARE WORKS
Richard E. Schantz and Robert E. Millstein 31 Mar. 1976 64 p
(Contracts N00014-75-C-0773; F30602-76-C-0094; ARPA Order 2901)
(AD-A023827; BBN-3266) Avail: NTIS HC A04/MF A01 CSCL 09/2

This report describes the function and operation of the National Software Works (NSW) system component known as the tool Foreman. A tool is a software development computer program made available to users through the multi-computer NSW system. The Foreman provides tools with their NSW execution environment, and ensures the smooth operation of tools within the NSW. Various aspects of the tool environment and the Foreman interface with other NSW system processes are described.
Author (GRA)

N77-10097*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HARDWARE ADDITIONS TO MICROPROCESSOR ARCHITECTURE AID SOFTWARE DEVELOPMENT
M. W. Sievers *In its* The Deep Space Network 15 Oct. 1976 p 28-33 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks.

N77-10826# Saab-Scania, Goteberg (Sweden).
FAULT TOLERANT COMPUTING FOR ON BOARD SPACECRAFT APPLICATIONS. VOLUME 1: SUMMARY
J. Torin, ed. Sep. 1975 101 p refs Prepared jointly with Christian Rovsing Ltd. 2 Vol.
(Contract ESTEC-2032/73-AK)
(RA-OBC-5-088; ESA-CR(P)-838-Vol-1) Avail: NTIS HC A06/MF A01

The theories of fault tolerant computing and their application to onboard spacecraft computer systems are presented. Faults in computer systems and ultrareliable computers are discussed and the state-of-the-art of fault tolerant computing is reviewed. Fault modes in an onboard computer system are identified and several different fault tolerant computer configurations based on the ESA-SAAB OBC modules are investigated. The two best suited configurations are studied further and compared in a trade-off together with a nonredundant configuration. The result of the trade-off illustrates the cost and improvements of fault tolerant computing in long life time applications. Methods to avoid faults in the design and development of software are investigated and checking philosophy is discussed. Author (ESA)

N77-10827# Saab-Scania, Goteberg (Sweden).
FAULT TOLERANT COMPUTING FOR ON BOARD SPACECRAFT APPLICATIONS. VOLUME 2: THEORETICAL STUDY
Jan Torin, ed. Sep. 1975 660 p refs Prepared jointly with Christian Rovsing Ltd. 2 Vol.
(Contract ESTEC-2032/73-AK)
(RA-OBC-5-056; ESA-CR(P)-838-Vol-2) Avail: NTIS HC A99/MF A01

The theories of fault tolerant computing and their application to onboard spacecraft computer systems are presented. Faults in computer systems and ultrareliable computers are discussed and the state-of-the-art of fault tolerant computing is reviewed. Fault modes in an onboard computer system are identified and several different fault tolerant computer configurations based on the ESA-SAAB OBC modules are investigated. The two best suited configurations are studied further and compared in a trade-off together with a nonredundant configuration. The result of the trade-off illustrates the cost and improvements of fault tolerant computing in long life time applications. Methods to avoid faults in the design and development of software are investigated and checking philosophy is discussed. Author (ESA)

N77-10298*# South Carolina Univ., Columbia.
RESPONSE OF LINEAR DYNAMIC SYSTEMS WITH RANDOM COEFFICIENTS
John Dickerson *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 741-745 (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10299*# Christopher Newport Coll., Va.
APPLICATIONS OF CATASTROPHE THEORY IN MECHANICS
Martin Buoncristiani and George R. Webb *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 747-756 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

N77-10304*# Massachusetts Univ., Amherst.
COMPUTER SYSTEMS: WHAT THE FUTURE HOLDS
Harold S. Stone *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 805-817 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N77-10828# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
FUNCTION SPACE NULL CONTROLLABILITY BY AUGMENTED DELAY FEEDBACK CONTROL
A. Thowsen Sep. 1975 11 p refs
(CSIR-WISK-183; ISBN-0-7988-0766-0) Avail: NTIS HC A02/MF A01

A simple method is presented for achieving function space null controllability of finite dimensional systems with delay feedback control. The system is augmented by another system of the same dimension, and linear feedback from the augmented system is used. Parameters in the delay feedback control laws are determined which yield function space null controllability in minimal time.
Author

N77-10829# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
ON POINTWISE DEGENERACY, CONTROLLABILITY AND MINIMAL TIME CONTROL OF LINEAR DYNAMICAL SYSTEMS WITH DELAYS
A. Thowsen Sep. 1975 38 p refs
(CSIR-WISK-180; ISBN-0-7988-0762-8) Avail: NTIS HC A03/MF A01

Controllability and degeneracy results for linear time invariant delay systems are surveyed and their relationships to minimal time, delay feedback control are discussed. A new construction for augmented delay feedback which achieves function space null controllability is then presented. New results on the pointwise degeneracy of dynamic systems with pure delays are also stated.
Author

N77-10830# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
A GRAPH THEORETIC APPROACH TO FAULT TOLERANT COMPUTING Annual Report, 1975 - 1976
W. L. Heimerdinger and L. A. Jack 22 Mar. 1976 48 p refs
(Contract F44620-75-C-0053; AF Proj. 9749)
(AD-A023954; F0357; AFOSR-76-0506TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report describes the results of an initial effort to identify properties of labelled graphs which are useful for the representation and analysis of fault tolerant digital systems. It builds on the results of previous work, where the feasibility of using LOGOS and Petri Nets to represent fault tolerant systems was assessed. The properties of conventional directed graphs were reviewed to identify any properties relevant to fault tolerance. Concepts such as balanced graphs, strongly connected graphs, cut sets, circuits, and reachability were identified as useful and shown to be applicable to labelled graphs. Next the fault phenomena

commonly seen in digital systems were classified, both from the viewpoint of their observable effects on the faulty system and from the more conventional viewpoint of their sources. Six functional Fault Classes were defined which accurately describe virtually all the common control related fault phenomena. The existing labelled graph theory was then examined for properties related to the Functional Fault Classes. Concepts such as liveness, boundedness, siphons, traps, and invariants among others were identified as useful. A taxonomy of structural and dynamic properties useful for fault tolerant analysis is given. The relationship between these properties and their application to fault tolerant system analysis is described. Finally, limitations of this approach and directions for future work are described. Author (GRA)

N77-10831# Wisconsin Univ., Madison.
LINEAR CONTROL THEORY AND RICCATI EQUATIONS Technical Summary Report
L. Tartar Feb. 1976 44 p ref
(Contract DAAG29-75-C-0024)
(AD-A023979; MRC-TSR-1555) Avail: NTIS HC A03/MF A01 CSCL 12/1

A general quadratic optimization problem is considered for a control system in a general Hilbert space setting. The operator Riccati equation which characterizes the optimal control is derived and general existence and regularity theorems are proved. The results have potential application to systems governed by linear partial differential equations, linear differential delay equations, etc. Author

N77-10832# Wisconsin Univ., Madison. Mathematics Research Center.
CANONICAL FORMS AND SPECTRAL DETERMINATION FOR A CLASS OF HYPERBOLIC DISTRIBUTED PARAMETER CONTROL SYSTEMS
David L. Russell Feb. 1976 66 p refs
(Contract DAAG29-75-C-0024; N00014-75-C-0239; NR Proj. 041-404)
(AD-A024080; MRC-TSR-1614) Avail: NTIS HC A04/MF A01 CSCL 12/1

The purpose of this paper is to study the problem of spectral determination via linear state feedback for a particular, simple class of hyperbolic control systems. GRA

N77-10833# California Univ., Berkeley.
OPTIMAL ADAPTIVE CONTROL OF LINEAR DISTRIBUTED-PARAMETER SYSTEMS WITH QUADRATIC CRITERIA
Calvin B. Y. Lee Jun. 1976 72 p refs
(Grant NSF MPS-74-21222)
(PB-255403/8; ORC-76-17) Avail: NTIS HC A04/MF A01 CSCL 12A

Various aspects of the problem of optimal control of a linear distributed-parameter system with quadratic criteria are treated. Both distributed and boundary control terms are presented. Certain deterministic versions of the problem are solved. This includes the case where there is a fixed terminal-time boundary condition. Random spacially-distributed disturbances are introduced into the dynamical equations of the deterministic model. A certainty equibalence result is obtained for this stochastic control problem. A Bayesian approach is used to establish a separation principle for the adaptive version of the problem, where we have partial observations and distributed Guassian random noise. GRA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N77-10834 Polytechnic Inst. of New York.
THE MONODROMY GROUP OF THE HYPERGOEMETRIC EQUATION Ph.D. Thesis
Kathryn Faith Kuiken 1976 103 p
Avail: Univ. Microfilms Order No. 76-23420

The monodromy group of the hypergeometric equation is determined, up to conjugacy within the two-dimensional special linear group over the complex numbers, by the triplet of traces for its three generating Mobius transformations. This triplet is then used to compute sets of parabolic generating elements in the non-degenerate case. The significance of the monodromy group for the solutions of the hypergeometric equation and conversely is investigated. It is shown that for the degenerate case of the hypergeometric equation, the monodromy group is metabelian. Then an algorithm is developed to compute the monodromy groups of the differential equations whose solutions arise from those of the hypergeometric equation by replacing the independent variable by some rational function, R(xi) of x. Such a result is employed to give criteria for determining which such rational substitutions, z = R(xi), will yield subgroups strictly contained in or coincident with the original monodromy group. Dissert. Abstr.

N77-10835# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
QUADRATURE FORMULAE FOR FINITE-PART INTEGRALS
H. R. Kutt Sep. 1975 164 p refs
(CSIR-WISK-178) Avail: NTIS HC A08/MF A01

The coefficients are presented for two kinds of quadrature formula for the numerical computation of a certain class of singular integrals, and the finite-part integrals involving an algebraic singularity, which do not exist in the sense of classical analysis. Author

N77-10836# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
LECTURES IN ANALYSIS AND APPLIED MATHEMATICS
Fritz John (N. Y. Univ.) Sep. 1975 106 p refs
(CSIR-WISK-185) Avail: NTIS HC A06/MF A01

Topics discussed are non-well posed problems in analysis; quasi-isometric mappings; classical mathematical theory of elasticity and its simplest nonlinear extension; wave propagation; and extremum problems with inequality constraints. A.H.

N77-10837# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
ON THE NUMERICAL EVALUATION OF FINITE-PART INTEGRALS INVOLVING AN ALGEBRAIC SINGULARITY
H. R. Kutt Sep. 1975 178 p refs
(CSIR-WISK-179) Avail: NTIS HC A09/MF A01

Two kinds of quadrature formula for evaluating finite-part integrals involving an algebraic singularity are studied. Physical examples of finite-part integrals and their definition based on distribution theory are considered. The most important properties of finite-part integrals are treated; their behavior under the most common rules for ordinary integrals are studied. A quadrature formula for equispaced stations is derived and one which is optimal in the sense of the gauss type quadrature. In connection with the latter formula, a new class of orthogonal polynomials are examined. A derivative-free error bound for the equispaced quadrature formula is derived. The error quantities which are independent of the integrand were computed for the equispaced quadrature formula and are also given. The computed error bounds are compared with the actual errors. Author

N77-10838# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
A NON-LINEAR MULTIPLE MIGRATION PROCESS
W. M. Getz Sep. 1975 21 p refs
(CSIR-WISK-182; ISBN-0-7988-0765-2) Avail: NTIS HC A02/MF A01

The Kolmogorov forward equations are derived for a nonlinear migration process occurring between a finite number of colonies. In addition to the migration of single individuals between colonies, the simultaneous migration of groups of individuals is allowed. The colonies are linear multiple-birth and death processes and the rate of migration between two colonies is dependent in a nonlinear way on the number of individuals in the colonies. The Kolmogorov forward equations are then used to derive a system of ordinary differential equations which can, under certain assumptions, be solved for the means, variance, and covariance terms of the joint multivariate distribution of the process. Author

N77-10839# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).

CONTINUOUS OPERATORS IN L-p AND GENERALIZED RANDOM PROCESSES: A KERNEL REPRESENTATION
R. Meidan Aug. 1975 21 p refs
(CSIR-WISK-177; ISBN-0-7988-0754-7) Avail: NTIS HC A02/MF A01

A generalized impulse response representation is developed for linear and continuous operators from D, the space of infinitely differentiable functions of compact support, into E, the space of complex valued functions on a set omega, equipped with the pointwise topology. This representation is employed in order to develop a similar representation for continuous linear operators from D into L sup p (omega), where omega is now a measure space. These results are then applied in order to obtain a kernel representation for continuous linear operators from L sup p (R sup n) into L sup q (R sup m) and a representation for generalized random processes. Author

N77-10840# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
CANONICAL FORMULATION OF QED CONSISTENT WITH OPERATOR SCHWINGER TERMS
M. Benayoun, G. Bordes, and B. Jouvet Mar. 1976 92 p refs
(LPTHE-76/6) Avail: NTIS HC A05/MF A01

A review is presented of the difficulties of attempting a canonical gauge invariant and covariant QED that would properly take into account c- and q-number Schwinger terms, whose existence is related to the photon self energy and to the anomalies of the photon-photon interaction. It is concluded that a cause of these difficulties lies in a priori requirements of covariance more stringent than absolutely necessary, particularly when it is realized that the non-commutativity of the second kind gauge group and Poincare group might well be the cause of this limitation. It is shown that a consistent canonical scheme can be developed. This scheme reproduces all the results and the spurious difficulties encountered in perturbative calculations, but has nevertheless the consequence that the observables are at the same time satisfactorily gauge-invariant and covariant. The content of this theory is examined from different aspects and the complete agreement of these complementary aspects of a canonical scheme is demonstrated. Author

N77-10841# California Univ., Livermore. Lawrence Livermore Lab.
PRELIMINARY DOCUMENTATION OF GEARIB: SOLUTION OF IMPLICIT SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS WITH BANDED JACOBIAN
A. C. Hindmarsh Feb. 1976 10 p refs
(Contract W-7405-eng-48)
(UCID-30130) Avail: NTIS HC A02/MF A01

A preliminary version of documentation for a new package, GEARIB, is reported. The package solves systems of ordinary differential equations in the implicit form Ay = g, with A and the partial derivative of g with respect to y treated in band matrix form. Author (ERA)

N77-10842# Ames Lab., Iowa.
INTERATIVE METHOD FOR VOLTERRA INTEGRAL EQUATIONS OF THE FIRST KIND
W. C. Peterson and R. J. Lambert Feb. 1976 29 p refs
(Contract W-7405-eng-82)
(IS-3841) Avail: NTIS HC A03/MF A01

An iterative method is developed to find an approximation to the least squares solution of minimum L2(0,1) norm, f sub 0 of a Volterra integral equation of the first kind. Author (ERA)

N77-10843# Montpellier Univ. (France). Dept. de Physique Mathematique.
POSITIVITY CONSTRAINTS IN LINEAR INVERSE PROBLEMS. PART 2: APPLICATIONS
P. C. Sabatier Dec. 1975 26 p refs
(PM/75/18) Avail: NTIS HC A03/MF A01

A complete method of solution of linear inverse problems with non negativity constraints was given previously. Here, problems with more particular applications in geophysics are discussed. First, when a statistical distribution of the errors is assumed the evolution of the set of solutions is described. The theory of ideal bodies, introduced recently by Parker, is then discussed. Conjectures of Parker's are proved. Algorithms to construct ideal bodies for any data set are given. Planar diagrams are studied, which illustrate the extent of the set of equivalent solutions by showing two moments of a solution vs each other for all possible solutions. The evolution of these diagrams when a new measurement is made gives a good idea of the interest of this measurement. Author (ESA)

N77-10844# Technical Univ. of Denmark, Lyngby. Inst. of Electromagnetics.
FORTRAN SUBROUTINES FOR NON-LINEAR MINIMAX OPTIMIZATION
K. Madsen and H. Schjaer-Jacobsen Feb. 1975 29 p refs
(TUD-R-135) Avail: NTIS HC A03/MF A01

A user-oriented description of two new nonlinear minimax optimization program packages, MINIM1 and MINIM2, is given. The MINIM1 program requires evaluation of the first partial derivatives of the residual functions whereas MINIM2 does not. The usage of the packages is demonstrated by a simple example. The programs have been implemented in double precision FORTRAN 4 on an IBM 370/165 computer. It is shown that the user is able to formulate and solve the general nonlinear minimax design problem either by using gradient information (MINIM1) or without gradients (MINIM2). Author (ESA)

N77-10845# National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.
A SURVEY OF NUMERICAL METHODS FOR DATA AND FUNCTION APPROXIMATION
M. G. Cox Apr. 1976 44 p refs Presented at the IMA Conf. on the State-of-the-Art in Numerical Anal., York, Engl., Apr. 1976
(NPL-NAC-65) Avail: NTIS HC A03/MF A01

A survey is presented of methods for determining mathematical approximations to functions and data in one independent variable. Interpolatory type methods as well as those based on approximation in the least-squares and other norms are presented. In recent years polynomial splines have proved to be a powerful and flexible class of approximating functions and, accordingly, a significant proportion of this survey is devoted to methods for spline approximation. Author (ESA)

N77-10846# Texas Univ., Austin. Center for Cybernetic Studies.
BASIC PROPERTIES OF THE POVERSE OF A MATRIX
A. Charnes, F. Palacios Gomey, and D. Whitman Feb. 1976 26 p refs
(Contract N00014-75-C-0569; NR Proj. 047-021)
(AD-A022687; CCS-245) Avail: NTIS HC A03/MF A01 CSCL 12/1

Some basic properties of poverses of matrices are studied. Previous characterizations are extended and a new one is given in terms of a super eigenvector which may be useful in non-linear inequalities theory. It is shown that the existence of poverses is independent of the rank of the matrices involved and that there are poverses of every rank. The convex set of poverses is characterized for a given matrix in terms of systems of linear inequalities which are amenable to linear programming computation. Some characterizations are also given of the extreme points of related non-polyhedral convex sets. Finally, some conditions connected with the actual computation of poverses are investigated. GRA

N77-10847# Wisconsin Univ., Madison. Mathematics Research Center.
ERROR BOUNDS AND UNIQUENESS FOR THE SOLUTIONS OF NONLINEAR, STRONGLY COUPLED, PARABOLIC SYSTEMS OF DIFFERENTIAL EQUATIONS
Karl Nickel Jan. 1976 24 p refs
(Contract DAAG29-75-C-0024)
(AD-A022748; MRC-TSR-1596) Avail: NTIS HC A02/MF A01 CSCL 12/1

The boundary value problem for a nonlinear, strongly coupled, parabolic system of differential equations in a box is considered. The system consists of 2 equations with 3 unknowns. The right sides of the differential equation satisfy Lipschitz conditions. Error bounds for an approximate solution are given. A uniqueness theorem is proven. The results are derived with the

aid of the theory of differential inequalities and by using a theorem of Kolmogorov for the solution of the Landau problem. GRA

N77-10848# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Guidance and Control Directorate.
INVESTIGATIONS OF DESCRIBING FUNCTIONS AND LIMIT CYCLES OF NONLINEAR SYSTEMS
R. E. Yates, C. F. Chen, and Y. T. Tsay 19 Jan. 1976 32 p refs
(DA Proj. 1M3-62303-A-214)
(AD-A022605; RG-76-45) Avail: NTIS HC A03/MF A01 CSCL 12/1

Methods for determining describing functions and limit cycles of single-valued nonlinear feedback systems are presented. A harmonic balance method is developed for finding the describing functions of multiplicative nonlinearities. The determination of limit cycles is accomplished by utilizing a newly-developed analytic method. This approach, which is completely computer oriented, imposed neither order limitations on the linear part nor restrictions on the number of possible stable limit cycles. Illustrative examples for both methods are included. Author (GRA)

N77-10849# National Bureau of Standards, Washington, D.C.
THE METHOD OF AVERAGING AND DOMAINS OF STABILITY FOR INTEGRAL MANIFOLDS Final Report
David E. Gilsinn Dec. 1975 35 p refs Repr. from SIAM Jnl. Applied Mathematics, v. 29, no. 4, Dec. 1975 p 628-660
(PB-253596/1) Avail: NTIS HC A03/MF A01 CSCL 12A

The investigation is centered on domains of stability of integral manifolds of solutions generated by nonlinear mechanical and electrical oscillatory systems with many degrees of freedom. These manifolds are families of solutions that exhibit stronger stability properties than individual solutions. The problem of estimating the domain of stability of an asymptotically stable integral manifold is reduced to computing the domain of stability of an associated autonomous system of differential equations. This is done by applying the method of averaging to the system generating the integral manifold thus removing angular and time dependences. The stability region of this associated system is then computed and a result is established showing that this region is contained in the stability region of the original system. Several examples, including a coupled van der Pol system of oscillators, are considered. GRA

N77-10850# Naval Research Lab., Washington, D.C.
FLUX-CORRECTED TRANSPORT MODULES FOR SOLVING GENERALIZED CONTINUITY EQUATIONS
Jay P. Boris Mar. 1976 93 p
(NRL Proj. H02-27E; DNA Proj. NWED-QAHXC062)
(AD-A023891; NRL-MR-3237) Avail: NTIS HC A05/MF A01 CSCL 12/1

Two FORTRAN subroutines for solving generalized continuity equations using optimized Flux-Corrected Transport techniques are documented. The basic finite-difference algorithm has fourth-order accurate phases and minimum residual diffusion. Phoenical antidiffusion has been generalized to moving grids and the entire algorithm has been vectorized for efficient pipeline computation. Nonlinear coupled systems of equations and multidimensional systems can be solved by repeated application of these routines. Eulerian, sliding rezone, and Lagrangian grids are allowed, and the calculations performed in Cartesian, cylindrical, and spherical coordinate systems. Author (GRA)

N77-10851# George Washington Univ., Washington, D.C. Inst. for Management Science and Engineering.
SECOND ORDER CONVERGENCE USING A MODIFIED ARMIJO STEP-SIZE RULE FOR FUNCTION MINIMIZATION
Garth P. McCormick 15 Jan. 1976 14 p refs
(Contract DAHC04-74-C-0002)
(AD-A023936; Serial-T-328; ARO-11559.6-ON) Avail: NTIS HC A02/MF A01 CSCL 12/1

Armijo's (1) step-size procedure for function minimization is modified to include second derivative information. Accumulation points using this procedure are shown to be stationary points with positive semi-definite Hessian matrices. Author (GRA)

N77-10852# Wisconsin Univ., Madison. Mathematics Research Center.
A SIMPLE PROOF OF THE HOBBY-RICE THEOREM
Allen Pinkus Feb. 1976 9 p refs
(Contract DAAG29-75-C-0024; Grant NSF MPS-72-00381-A01)
(AD-A024078; MRC-TSR-1612) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper presents a simple proof of the Hobby-Rice theorem, and a matrix version of the above theorem. GRA

N77-10853# Wisconsin Univ., Madison. Mathematics Research Center.
EQUATIONS WITH ORDER PRESERVING PROPERTIES
L. Tartar Feb. 1976 55 p refs
(Contract DAAG29-75-C-0024)
(AD-A024020; MRC-TSR-1580) Avail: NTIS HC A04/MF A01 CSCL 12/1

The author first proves positivity properties of solutions of second order elliptic equations (maximum principle) by variational techniques. Then, using abstract fixed point theorems for increasing maps in ordered sets, he obtains existence and order preserving properties of solutions of some nonlinear equations, variational inequalities and quasivariational inequalities. Finally, some order preserving properties of generalized Riccati equations are introduced briefly. GRA

N77-10854# Wisconsin Univ., Madison. Mathematics Research Center.
ON MINIMIZING THE SUM OF SQUARES OF FUNCTIONAL VECTOR NORMS OF DIFFERENTIAL OPERATORS UNDER CONSTRAINTS Technical Summary Report
Richard C. Brown (Alabama Univ., University) and Allan M. Krall (Pa. State Univ., University Park) Feb. 1976 28 p refs
(Contract DAAG29-75-C-0024)
(AD-A023943; MRC-TSR-1582) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper considers the problem of minimizing the sum of squares of functional vector norms of differential operators under a general class of constraints. Several sufficient conditions are given for the existence of a solution. The minimization problem is shown to involve the adjoint of a naturally defined differential system with matrix coefficients. The minimizing function is characterized as the solution of a boundary value problem, in terms of the differential operator, and also the adjoint boundary value problem. GRA

N77-10855# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
GRAPH SUBSTITUTION AND SET PACKING POLYTOPES
Egon Balas and Eitan Zemel Jan. 1976 29 p refs
(Contract N00014-75-C-0621; Grant NSF MPS-73-08534-A02; NR Proj. 047-048)
(AD-A023853; RR-384; WP-55-75-76) Avail: NTIS HC A03/MF A01 CSCL 12/2

Facets of the set packing polytope provide strong cutting planes for set packing and partitioning problems. Set packing polytopes are in a one to one correspondence with graphs. The facets of P(G), the set packing polytope associated with the graph G are related to certain subgraphs of G. Of particular interest are those subgraphs G' which are facet producing, i.e., which give rise to facets of P(G') that cannot be obtained by lifting a facet of P(G' the set (x)), for any vertex x of G'. A necessary and sufficient condition is given for the graphs obtained by Chvatal's substitution procedure to be facet producing. GRA

N77-10101*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN ALGEBRAIC APPROACH TO IMAGE DE-SMEARING: SYMMETRIES OF POLYNOMIALS AND THEIR ZEROS
D. L. Johnson *In its* The Deep Space Network 15 Oct. 1976 p 58-63 (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 12A

N77-10102*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE FAST DECODING OF REED-SOLOMON CODES USING NUMBER THEORETIC TRANSFORMS
I. S. Reed (Univ. of Southern Calif.), L. R. Welch (Univ. of Southern

Calif.), and T. K. Truong *In its* The Deep Space Network 15 Oct. 1976 p 64-77 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 12A

N77-10282*# Texas Univ., Austin. Inst. for Computational Mechanics.
SOME CONVERGENCE PROPERTIES OF FINITE ELEMENT APPROXIMATIONS OF PROBLEMS IN NONLINEAR ELASTICITY WITH MULTI-VALUED SOLUTIONS
J. T. Oden *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 555-562 ref (For primary document see N77-10265 01-31)
(Grant NSF ENG-75-07846)
Avail: NTIS HC A20/MF A01

N77-10300*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STABILITY OF NEUTRAL EQUATIONS WITH CONSTANT TIME DELAYS
L. Keith Barker and John L. Whitesides (George Washington Univ.) *In its* Advan. in Eng. Sci., Vol. 2 1976 p 757-768 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01 CSCL 12A

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N77-10856# Manchester Univ. (England). Dept. of Mathematics (Statistics).
PERIODOGRAM ANALYSIS AND CYCLE DETECTION WITH REGULARLY MISSED OBSERVATION POINTS
V. Haggan Aug. 1975 18 p refs
(TR-69) Avail: NTIS HC A02/MF A01

The problem of detecting circadian rhythms in bodily functions is studied. One of the difficulties in finding such periodicities lies in the fact that, of necessity, the data may be unequally spaced. A method for detecting periodicities when observation points are regularly missed is described, involving a modified form of periodogram analysis. This technique is illustrated by application to both simulated and real data. Author

N77-10857# Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
APPLICATION OF DECISION RISK ANALYSIS IN OPERATIONAL TESTS AND EVALUATION Final Summary Report
Douglas C. Montgomery, Leslie G. Callahan, Jr., and Harrison M. Wadsworth Sep. 1975 57 p
(Contract DAAG39-75-C-0097)
(AD-A024205) Avail: NTIS HC A04/MF A01 CSCL 15/5

The objectives of this project were to develop a methodology with a set of procedures for applying decision/risk analysis to the design of operational tests and the analysis of operational test results. It was assumed that existing principles and techniques of decision theory and risk analysis are applicable to this problem. GRA

N77-10858# Wisconsin Univ., Madison. Mathematics Research Center.
GAUSSIAN PROCESSES ON COMPACT SYMMETRIC SPACES
R. Askey and N. H. Bingham Feb. 1976 35 p refs
(Contract DAAG29-75-C-0024; Grant NSF MPS-75-06687-A02)
(AD-A024076; MRC-TSR-1603) Avail: NTIS HC A03/MF A01 CSCL 12/1

A large class of Gaussian processes whose parameters run over spheres and projective spaces is constructed and the connection between the spaces on which a given function is parameterized is considered. GRA

N77-10859# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
PROCEEDINGS OF THE INTERNATIONAL CONGRESS FOR STEREOLOGY (4TH)
Ervin E. Underwood, ed. (Ga. Inst. of Technol.), Roland deWit, ed., and George A. Moore, ed. Jan. 1976 548 p refs Held at Gaithersburg, Md., 4-9 Sep. 1975
(PB-254465/8; NBS-SP-431; LC-76-8668) Avail: NTIS HC A23/MF A01 CSCL 12A

Topics covered are principles and mathematical developments, pattern recognition, instrumentation, three dimensional reconstruction and stereological applications in materials and biology. Additional topics covered in the workshops are mathematical foundations of stereology, particle science, and size distributions. GRA

N77-10860# Wisconsin Univ., Madison. Mathematics Research Center.
EMPIRICAL BAYES ESTIMATION OF A DISTRIBUTION SURVIVAL FUNCTION FROM RIGHT CENSORED OBSERVATIONS
V. Susaria and J. VanRyzin Feb. 1976 26 p refs
(Contract DAAG29-75-C-0024; Grant PHS-CA-18332)
(AD-A024079; MRC-TSR-1613) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper provides an empirical Bayes approach to the problem of nonparametric estimation of a distribution (or survival) function when the observations are censored on the right. The results use the notion of a Dirichlet process prior (Ferguson, 1973, Ann. Stat., 2, 209-230). The paper presents a generalization to the case of right censored observations of the rate result of an empirical Bayes nonparametric estimator of a distribution function of Korwar and Hollander ((1974, Tech. Rept. No. 288, Dept. of Statistics, Florida State University) in the uncensored case. The rate of asymptotic convergence to optimality is shown to be the best obtainable for the problem considered. GRA

N77-10861# California Univ., Berkeley. Statistical Lab.
DESCRIPTIVE STATISTICS FOR NONPARAMETRIC MODELS III. DISPERSION
P. J. Bickel and E. L. Lehmann Nov. 1975 36 p refs
(Contract N000[illegible]-A-0200-1038; Grant NSF GP-38485; NR Proj. 042-036)
(AD-A023768) Avail: NTIS HC A03/MF A01 CSCL 12/1

Measures of dispersion are defined as functionals satisfying certain equivariance and order conditions. Attention is restricted to symmetric distributions. Different measures are compared in terms of asymptotic relative efficiency, i.e., the inverse ratio of their standardized variances. The efficiency of a trimmed to the untrimmed standard deviation turns out not to have a positive lower bound even over the family of Tukey models. Postive lower bounds for the efficiency (over the family of all symmetric distributions for which the measures are defined) exist if the trimmed standard deviations are replaced by pth power deviations. However, these latter measures are no longer robust, although for p = 2 they are more robust than the standard deviation. The results of the paper suggest that a positive bound to the efficiency may be incompatible with robustness but that trimmed standard deviations and Pth power deviations for p = 1 or 1.5 are quite satisfactory in practice. Author (GRA)

N77-10100*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THREE-LEVEL SAMPLER HAVING AUTOMATED THRESHOLDS
R. F. Jurgens *In its* The Deep Space Network 15 Oct. 1976 p 52-57 refs (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 12A

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N77-10862# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.
STUDY AND ANALYSIS OF AN OPTIMUM COMMAND AND CONTROL CLASS [ETUDE ET ANALYSE D'UNE CLASSE DE COMMANDE OPTIMALE]
O. Badr 10 Feb. 1975 38 p refs In FRENCH

(CEPHAG-6/75) Avail: NTIS HC A03/MF A01

A review of various command and control types, optimal and suboptimal, was performed and classification assigned according to the various models. The influence of a modelling error on command optimality is discussed. The problem of command correction when starting from erroneous models is dealt with and an algorithm correcting the real process behavior was written and tested on a simulated example. ESA

N77-10863# Texas Univ., Austin. Center for Cybernetic Studies.

NECESSARY AND SUFFICIENT CONDITIONS FOR A PARETO-OPTIMUM IN CONVEX PROGRAMMING

A. Ben-Israel, A. Ben-Tal (Technion-Israel Inst. of Technology), and A. Charnes Jan. 1976 20 p refs

(Contract N00014-75-C-0569; NR Proj. 047-021)

(AD-A022686; CCS-255-Rev) Avail: NTIS HC A02/MF A01 CSCL 12/1

Necessary and sufficient conditions for Pareto optimality are derived for problems involving convex criteria and convex constraints. For a wide class of convex functions, the characterization of Pareto optimality is given in terms of systems of linear programs, which, under suitable regularization conditions, reduce to a single linear program. The consideration of a system of linear programs and their duals leads naturally to a system of partial prices associated with a Pareto optimum. Author (GRA)

N77-10864# Yale Univ., New Haven, Conn. School of Organization and Management.

DECISION AND CONTROL MODELS IN OPERATIONS RESEARCH Final Report, 1 Jan. 1974 - 31 Dec. 1975

Harvey M. Wagner 27 Feb. 1976 22 p

(Grants DAHC04-74-G-0088; DAHC04-75-G-0079)

(AD-A024190; ARO-11639.6-M) Avail: NTIS HC A02/MF A01 CSCL 15/5

The research concentrated on one major topic of investigation: Statistical properties of inventory models. The analysis dealt with comparing the operating characteristics of several important stockage rules when the underlying demand distribution parameters were estimated from a limited sample of historical data (say, 13, 26, or 52 observations). Particular attention was given to the frequently observed case where the probability of zero demand occurring within any time period was significantly large (hence, say, half of the historical observations indicated zero demand), but the positive levels of demand were not necessarily small. The context of the analyses was a large-scale inventory system containing thousands of individual items, and thus, the computational burden of implementing the stockage policies was recognized in the comparison of different stockage rules. The research approach encompassed applied Markovian probability analysis and computer simulation analysis containing sophisticated statistical autoregressive time series methods. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N77-10865# Wisconsin Univ., Madison. Mathematics Research Center.

A MODEL OF SET THEORY WITH A UNIVERSAL SET Summary Report

Emerson Mitchell Feb. 1976 37 p ref

(Contract DAAG29-75-C-0024)

(AD-A023978; MRC-TSR-1549) Avail: NTIS HC A03/MF A01 CSCL 12/1

Let T be the theory of the language of set theory saying that: (1) Sets are extensional; (2) Every set has a universal complement, i.e. given a set x there is a set y such that every set z is a member of y if and only if it is not a member of x; (3) Every set x has a power set containing exactly the subsets of x; (4) The result of replacing every member of a well-founded set by some set is a set; (5) The well-founded sets form a model of Zermelo-Fraenkel set theory. Then within the universe V of Zermelo-Fraenkel set theory there is a definable internal model of T. The members of the internal model are chosen by an inductive definition within V, and then a new membership relation is inductively defined such that the members of the internal model with the defined membership relation satisfy T. It happens that the members of the internal model which are well-founded on the defined membership relation form an isomorphic copy of V. Thus one can regard the construction as an extension of V to a model of T. Corollary: T is consistent if and only if Zermelo-Fraenkel set theory is consistent. GRA

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N77-10866# Yeshiva Univ., New York. Belfer Graduate School.

SYSTEMATIC STUDY OF PYROELECTRICITY. LIGHT SCATTERING AND PYROELECTRICITY IN FERROELECTRICS Technical Report, 1 Apr. - 30 Sep. 1975

Raccah Bell, P. M. Apr. 1976 48 p refs

(Contract DAAB07-74-C-0470; ARPA Order 2573)

(AD-A023942; ECOM-74-0470-3) Avail: NTIS HC A03/MF A01 CSCL 20/3

The results of two studies of pyroelectric materials are reported. In the first, a Raman scattering study of KNbO3, anomalous scattering is found which can be related directly to the dynamic disorder which has been invoked to explain the results of earlier X-ray and neutron scattering studies and which provides the starting point for the generalized molecular field theory of ferroelectricity proposed elsewhere by the authors. The second is an analysis of the physical properties of pyroelectric materials which determine their performance as vidicon targets. GRA

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N77-10867*# Nielsen Engineering and Research, Inc., Mountain View, Calif.

AN ANALYTICAL STUDY OF NOISE GENERATION BY SUBSONIC FLOWS IN THE PRESENCE OF RIGID SURFACES

J. P. Wooley, K. Karamcheti, and J. L. Guenther Oct. 1976 114 p refs

(Contract NAS1-13699)

(NASA-CR-145027; NEAR-TR-118) Avail: NTIS HC A06/MF A01 CSCL 20A

A general analytical method is developed for determination of the radiated noise field from highly sheared, subsonic flows in the presence of rigid surfaces. The method is specifically formulated to use measurable flow field properties as the basis input data for calculations. The governing equations of a viscous, incompressible fluid are employed to determine approximately the so-called shear noise source strength distribution in the flow. Mean rates of strain and fluctuating velocity covariances are the fundamental input data for calculations. The method is applied to the wall jet region of a circular jet impinging at 45 deg to an infinite plane surface. Velocity field measurements of Foss are used to describe the required flow properties. Comparisons of calculated results with measured surface pressures and sound pressure levels are given and discussed. Author

N77-10868# Southampton Univ. (England). Inst. of Sound and Vibration Research.

NOISE REDUCTION IN CENTRIFUGAL FANS: A LITERATURE SURVEY

W. Neise Jun. 1975 47 p refs

(ISVR-TR-76) Avail: NTIS HC A03/MF A01

In order to help the industrial engineer construct quieter fans, the research work done by various experimenters during the last fifteen years on noise reduction methods in centrifugal

fans used in air conditioning and ventilating equipment is summarized. Only those investigations are included in which an attempt was made to reduce the generated sound by modifying the fan itself. Most of the work described was aimed at reducing the blade passage sound, but in some cases a decrease of the broad band noise was also obtained. Three different centrifugal impeller designs are dealt with: multivane impellers with forward curved blades, impellers with backward curved blades, and impellers with radial blades. The following methods are described: increasing the distance between impeller tip and cutoff, angle of inclination between impeller blades and cutoff edge, staggering of blades of double inlet blowers and double row impellers, and transition meshes at the leading and trailing edges of the rotor blades. Future research work on the main source regions of broadband noise is suggested. Author (ESA)

N77-10869# Grenoble Univ. (France). Centre d'Etude des Phenomenes Aleatoires et Geophysiques.

CHARACTERIZATION OF THE MEAN VALUE IN A REVERBERATING MEDIUM VIA INTERAMBIGUITY UPON INPUT/OUTPUT COMPRESSION [CARACTERISATION DE LA VALEUR MOYENNE D'UN MILIEU REVERBERANT PAR INTERAMBIGUITE COMPRESSION ENTREE-SORTIE]

G. Jourdain and P. Lorenzino 28 May 1975 58 p refs In FRENCH

(CEPHAG-25/75) Avail: NTIS HC A04/MF A01

A series of experiments performed with the diffuse echo simulator are presented with a view to identifying the mean value of a reverberating simulated medium. Signals with high potential resolution in time compression were used to excite the medium, and a generalized input/output intercorrelation was used followed by a statistical mean. The signals used were PSK with or without carrier; the various media to be identified are described. The processing methods using a convolver or a hybrid correlator with digital accumulation are detailed together with the relevant experimental setups. Results in the cases of homogeneous or inhomogeneous, deterministic or random media are discussed and conclusions are drawn. ESA

N77-10870# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Inst. fuer Turbulenzforschung.

ON THE USE OF ACOUSTICAL HOLOGRAPHY TO LOCATE SOUND SOURCES ON COMPLEX STRUCTURES

Walter F. King and Earl E. Watson (Universal Oil Prod., Decatur, Ala.) 12 Apr. 1976 35 p refs Sponsored in part by Naval Sea System Command

(DLR-FB-76-12) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 13.80

An experimental technique is presented for the identification of far field sound sources on complex vibrating structures. Results are given for a preliminary investigation designed to determine the feasibility of applying a modified form of acoustical holography to the location of sound sources on a three-bladed ventilator fan. Optical and computer sound source reconstructions are compared and analyzed. Results of the preliminary study are very encouraging and indicate the versatility and usefulness of this technique for modifying and controlling far field noise radiation from complex vibrating structures. Author (ESA)

N77-10871# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abteilung Theoretische Gasdynamik.

SOUND ATTENUATION IN MULTIPLY LINED RECTANGULAR DUCTS INCLUDING THE EFFECTS OF THE WALL IMPEDANCE DISCONTINUITIES. PART 1: LINERS IN SERIES

Werner Koch 15 Jan. 1976 113 p refs In GERMAN; ENGLISH summary Report will also be announced as translation

(DLR-FB-76-07) Avail: NTIS HC A06/MF A01 DFVLR, Cologne DM 41.60

An exact solution for the computation of sound attenuation in multiply lined ducts at zero convection velocity including the effects of the wall impedance discontinuities is given by means of an extended Wiener-Hopf method. This solution is evaluated numerically for a realistic impedance model. For the fundamental mode the influence of the different parameters is demonstrated in several diagrams for one- and two-layer, one- and two-part liners in series. In some examples considerable changes are found for the optimum impedance value due to the inclusion of the effects of end reflections. The advantage of greater bandwidth is shown for two-layer and two-part liners. Author (ESA)

N77-10872# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Stroemungsmechanik.

DISTORTION OF WEAK SHOCK AND SOUND WAVES BY ATMOSPHERIC TURBULENCE

Roland Stuff 31 Mar. 1976 57 p refs In GERMAN; ENGLISH summary Report will also be announced as translation

(DLR-FB-76-25) Avail: NTIS HC A04/MF A01; DFVLR, Cologne DM 27.30

Batchelor's theory of single scattering of sound and shock waves is generalized to include the case of a polytropic atmosphere. The influence of atmospheric stratification was investigated by means of a plane shock wave moving vertically downwards in a CINA-standard atmosphere. The shock wave is supposed to enter into the atmospheric boundary layer at an altitude of 1000 m. The scattered waves are distorted by the stratification in the same way as the original wave.

Author (ESA)

N77-10873# European Space Agency, Paris (France).

EXPERIMENTS ON THE FEASIBILITY OF AERO-ACOUSTIC MEASUREMENTS IN THE 3-m LOW SPEED WIND TUNNEL OF THE DFVLR-AVA

Friedrich-Reinhard Grosche et al Sep. 1976 36 p refs Transl. into ENGLISH of "Expt. zur Moeglichkeit von aeroakustischen Messungen im 3-m-Niedergeschwindigkeitswindkanal der DFVLR-AVA", DFVLR, Goettingen, West Ger. Report DLR-FB-75-52, 26 Nov. 1975 Original German report available from DFVLR, Cologne DM 19.90

(ESA-TT-311; DLR-FB-75-52) Avail: NTIS HC A03/MF A01

The experiments include measurements of the tunnel noise and measurements of the noise of a high subsonic jet emanating from a nozzle of 5 cm diameter located in a test section of the wind tunnel. The noise level of the jet was 10 to 20 db higher at frequencies about 2 kHz than the noise level of the tunnel, although a large airplane model producing additional flow noise was installed in the test section. Author (ESA)

N77-10874# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.

SIMPLE CORRELATION EFFECTS IN SURFACE SCATTER

Franz B. Tuteur Apr. 1976 22 p refs

(Contract N00014-75-C-0298; NR Proj. 083-322)

(AD-A023918; TR-CS-8) Avail: NTIS HC A02/MF A01 CSCL 20/1

This report contains some simple results concerning the correlation time or distance of scattered received signals when the source is a single-frequency tone. Results are given for: the correlation distance between two receivers in a spatial array; the correlation distance in a situation where the source and receiver move together relative to a stationary rough surface, and correlation time at a receiver after several scattering bounces. In all cases it is found that the correlation times or distances are simple functions of the surface correlation time and the Rayleigh parameter. GRA

N77-10875# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.

ASYMMETRIC DOPPLER AMPLITUDES IN THE SURFACE SCATTER CHANNEL

Franz B. Tuteur and Henti Tung 1 Apr. 1976 21 p refs

(Contract N00014-75-C-0298; NR Proj. 083-322)

(AD-A023828; TR-CS-7) Avail: NTIS HC A02/MF A01 CSCL 20/1

The generation of asymmetric Doppler side bands in scatter channels in which the transmitter and receiver are at different depths has been demonstrated in several recent papers. (E. Y. Harper and F. M. Labianca, J. Acoust, Soc. Am. 57, 1044-1051 (1975) and 58, 349-364 (1975)). In these papers the wave equation was solved by using a perturbation procedure. In the present paper a similar result is obtained by using a modified Fresnel expansion of the Kirchoff integral. The resulting expansion, which is correct to third order but contains only terms up to

second order is then easily manipulated by standard methods. The ratio of side band amplitudes can be found by solving a fairly simple algebraic equation, and the general features of the result appear to be qualitatively similar to those observed in the earlier studies. Author (GRA)

N77-10876# Bolt, Beranek, and Newman, Inc., Arlington, Va.
COMPUTER PROGRAMS FOR THE AUSEX (AIRCRAFT UNDERSEA SOUND EXPERIMENT) AIR-WATER ACOUSTIC PROPAGATION MODEL
David Sachs, Leo Sledjeski, and Raya Stern 28 Jan. 1976 154 p refs
(Contract N00014-75-C-0532; ARPA Order 2909)
(AD-A024253; BBN-TM-W307) Avail: NTIS HC A08/MF A01 CSCL 20/1

This report is a user's guide for a computerized mathematical model development in support of the Aircraft Undersea Sound Experiment (AUSEX) Program. The AUSEX Program is funded and directed by the Defense Advanced Research Projects Agency (DARPA). The subject mathematical model is termed the AUSEX Acoustic Propagation Model, and it describes the acoustic propagation from a moving sound source in air, to and across a rough air-water interface, and subsequently through the water to an arbitrarily located point-acoustic receiver. This report describes the computer program architecture and the input and output data associated with the program's use. Two examples of the program's application are included. In addition, the complete program listing for the FORTRAN IV coding is included. GRA

N77-10236*# West Virginia Univ., Morgantown.
INFLUENCE OF ACOUSTICS IN SEPARATION PROCESSES
Harold V. Fairbanks *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 61-65 refs (For primary document see N77-10230 01-31)
Avail: NTIS HC A16/MF A01

N77-10306*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
SOUND PROPAGATION THROUGH NONUNIFORM DUCTS
Ali Hasan Nayfeh *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 821-833 refs (For primary document see N77-10305 01-31)
(Contract NAS1-13884)
Avail: NTIS HC A20/MF A01

N77-10307*# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
NONLINEAR PERIODIC WAVES
Lu Ting *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 837-850 refs (For primary document see N77-10305 01-31)
(Grant NsG-1291)
Avail: NTIS HC A20/MF A01

N77-10308*# Stanford Univ., Calif.
FEATURES OF SOUND PROPAGATION THROUGH AND STABILITY OF A FINITE SHEAR LAYER
S. P. Koutsoyannis *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol 3 1976 p 851-860 refs Sponsored by NASA (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10309*# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
EFFECTS OF HIGH SUBSONIC FLOW ON SOUND PROPAGATION IN A VARIABLE-AREA DUCT
A. J. Callegari and M. K. Myers (George Washington Univ., Washington, D. C.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 861-872 refs Sponsored by NASA (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10310*# General Electric Co., Philadelphia, Pa.
EFFECTS OF MEAN FLOW ON DUCT MODE OPTIMUM SUPPRESSION RATES
Robert E. Kraft and William R. Wells (Cincinnati Univ.) *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 873-882 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10311*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INLET NOISE SUPPRESSOR DESIGN METHOD BASED UPON THE DISTRIBUTION OF ACOUSTIC POWER WITH MODE CUTOFF RATIO
Edward J. Rice *In its* Advan. in Eng. Sci., Vol. 3 1976 p 883-894 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 20A

N77-10313*# New Jersey Inst. of Technology, Newark.
A SIMPLE SOLUTION OF SOUND TRANSMISSION THROUGH AN ELASTIC WALL TO A RECTANGULAR ENCLOSURE, INCLUDING WALL DAMPING AND AIR VISCOSITY EFFECTS
Amir N. Nahavandi, Benedict C. Sun, and W. H. Warren Ball *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 907-916 ref (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10314*# Pennsylvania State Univ., University Park. Applied Physics Lab.
PARAMETRIC ACOUSTIC ARRAYS: A STATE OF THE ART REVIEW
Francis Hush Fenlon *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 917-932 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10315*# Toronto Univ. (Ontario).
NON-DIMENSIONAL GROUPS IN THE DESCRIPTION OF FINITE-AMPLITUDE SOUND PROPAGATION THROUGH AEROSOLS
David S. Scott *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 933-945 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10319*# Mississippi Univ., University.
A MICROSCOPIC DESCRIPTION OF SOUND ABSORPTION IN THE ATMOSPHERE
H. E. Bass *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol 3 1976 p 975-986 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10320*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PROPAGATION OF SOUND IN TURBULENT MEDIA
Alan R. Wenzel *In its* Advan. in Eng. Sci., Vol. 3 1976 p 987-995 refs (For primary document see N77-10305 01-31)
(Contract NAS1-14101)
Avail: NTIS HC A20/MF A01 CSCL 20A

N77-10322*# Georgia Inst. of Tech., Atlanta.
DIFFRACTION OF SOUND BY NEARLY RIGID BARRIERS
W. James Hadden, Jr. and Allan D. Pierce *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1009-1018 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10323*# Georgia Inst. of Tech., Atlanta.
THE LEAKING MODE PROBLEM IN ATMOSPHERIC ACOUSTIC-GRAVITY WAVE PROPAGATION
Wayne A. Kinney and Allan D. Pierce *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1019-1030 refs Sponsored by AF (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

N77-10374*# Oklahoma Univ., Norman.
ACOUSTIC DISTURBANCES PRODUCED BY AN UNSTEADY SPHERICAL DIFFUSION FLAME
Maurice L. Rasmussen *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 4 1976 p 1653-1664 refs (For primary

document see N77-10345 01-31)
Avail: NTIS HC A22/MF A01

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N77-10877*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VIBRATION-TRANSLATION ENERGY TRANSFER IN VIBRATIONALLY EXCITED DIATOMIC MOLECULES Ph.D. Thesis - York Univ., Toronto
Robert Lawrence McKenzie Washington Oct. 1976 242 p refs
(NASA-TR-R-466; A-6453) Avail: NTIS HC A11/MF A01 CSCL 20H

A semiclassical collision model is applied to the study of energy transfer rates between a vibrationally excited diatomic molecule and a structureless atom. The molecule is modeled as an anharmonic oscillator with a multitude of dynamically coupled vibrational states. Three main aspects in the prediction of vibrational energy transfer rates are considered. The applicability of the semiclassical model to an anharmonic oscillator is first evaluated for collinear encounters. Second, the collinear semiclassical model is applied to obtain numerical predictions of the vibrational energy transfer rate dependence on the initial vibrational state quantum number. Thermally averaged vibration-translation rate coefficients are predicted and compared with CO-He experimental values for both ground and excited initial states. The numerical model is also used as a basis for evaluating several less complete but analytic models. Third, the role of rational motion in the dynamics of vibrational energy transfer is examined. A three-dimensional semiclassical collision model is constructed with coupled rotational motion included. Energy transfer within the molecule is shown to be dominated by vibration-rotation transitions with small changes in angular momentum. The rates of vibrational energy transfer in molecules with rational frequencies that are very small in comparison to their vibrational frequency are shown to be adequately treated by the preceding collinear models. Author

N77-10878*# Kanner (Leo) Associates, Redwood City, Calif.
INTERPRETATION OF THE VARIATIONS WITH TEMPERATURE OF THE PROPERTIES OBSERVABLE BY ELECTRON PARAMAGNETIC RESONANCE OF A FAMILY OF CARBON BLACKS IRRADIATED WITH NEUTRONS
F. Carmona and P. Delhaes Washington NASA Aug. 1976 8 p refs Transl. into ENGLISH from Compt. Rend., Ser. B (France), v. 272, 15 Mar. 1971 p 649-652
(Contract NASw-2790)
(NASA-TT-F-17204) Avail: NTIS HC A02/MF A01 CSCL 20H

A phenomenologic model taking into account the interactions of two spin systems is used to interpret the variations of the g factor and line width of a neutron-irradiated P 33 carbon black as a function of temperature between 4.2 and 300 K. Author

N77-10879*# Kanner (Leo) Associates, Redwood City, Calif.
PARAMAGNETIC CENTERS PRODUCED BY OXIDATION OF CARBON BLACK
M. F. Charlier, G. Kappel, F. Malan, A. Charlier, and P. Taglang Washington NASA Aug. 1976 7 p refs Transl. into ENGLISH from Carbon (France), v. 8, 1970 p 692-693
(Contract NASw-2790)
(NASA-TT-F-17205) Avail: NTIS HC A02/MF A01 CSCL 20H

Powdered and pelletized samples of carbon black were oxidized to determine the effect of this phenomenon on the establishment of electron spins. The oxidation of carbon black was found to be characterized by specific EPR properties: a resonance line with a small width at half-maximum and a g factor in the vicinity of 2.0035. Author

N77-10880# Los Alamos Scientific Lab., N.Mex.
ION BEAM LIMITS
C. B. Mills Oct. 1975 12 p refs
(Contract W-7405-eng-36)
(LA-6153) Avail: NTIS HC A02/MF A01

The cooperative physical processes of ion source and ion beam physics in magnetic fields can be separated into plasma internal motions, motion from the source plasma into the beam, and beam formation. A few experiments demonstrate that these processes are consistent with elementary laws of charge diffusion. Ion beam current limits are almost independent of magnetic field and have magnitudes consistent with classical diffusion processes. Ion current is proportional to applied potential gradient up to high voltage breakdown values, which are determined by electrode geometry and secondary electron currents. Beam plasma stability, which is necessary for isotope separation using ion beam technology, depends on the formation of a dense, charge-neutralizing plasma as well as on ion source stability. Author (ERA)

N77-10881# Freiburg Univ. (West Germany). Inst. fuer Physik.
A STUDY OF SCF MO BASIS SETS IN CI CALCULATIONS BASED ON THE HNO POTENTIAL ENERGY SURFACES
A. A. Wu Dec. 1975 44 p refs Sponsored by Deut. Forschungsgemeinschaft
(Rept-M-3) Avail: NTIS HC A03/MF A01

In limited CI (configuration interaction) calculations based on SCF MO's, results can be quite dependent on the choice of MO bases, especially if potential surfaces for several electronic states and for widespread geometrical arrangements are desired. This dependence and, therefore, the proper choice and efficient use of SCF MO bases are closely examined with a pilot calculation on the electronic states of the HNO system. In addition to the conventional use of single configuration SCF MO sets, the use of certain mixture sets is invoked to improve the situation. These mixture sets are composed of symmetry MO subsets associated with different SCF configurations calculated at the same geometrical arrangement. The usefulness of this new feature is amply explored. With these pilot studies as background, a procedure of limited CI based on optimal generalized combinations of SCF MO symmetry subsets is prescribed for potential energy surface calculations. Author (ESA)

N77-10882# National Bureau of Standards, Washington, D.C.
CROSS SECTIONS FOR IONIZATION OF INNER-SHELL ELECTRONS BY ELECTRON IMPACT (ABSTRACT) Final Report
C. J. Powell 5 Sep. 1975 5 p refs Repr. from Journal of Vacuum Science and Technol., vol. 13, no. 1, Jan./Feb. 1976 p 219-220 Sponsored by ERDA
(PB-252440/3) Avail: NTIS HC A02/MF A01 CSCL 07D

Inner shell ionization cross section data in the range of interest for quantitative Auger electron spectroscopy are surveyed. Calculated semiempirical and experimental data were intercompared graphically and by deriving effective values of the Bethe parameters b(nl) and c(nl) from fits of cross sections delta(nl) to a linearized form of the Bethe equation for inner shell ionization. The derived values of b(nl) were generally consistent with those expected from photoabsorption data if account was taken of the distribution of differential oscillator strength with respect to excitation energy and the resultant expected variation of b(nl) near threshold. GRA

N77-10883# National Bureau of Standards, Boulder, Colo. Laboratory Astrophysics Div.
BIBLIOGRAPHY OF LOW ENERGY ELECTRON AND PHOTON CROSS SECTION DATA (THROUGH DECEMBER 1974) Final Report
Lee J. Kieffer Mar. 1976 234 p refs
(PB-252687/9; NBS-Sp-426; LC-75-619200) Avail: NTIS HC A11/MF A01 CSCL 07D

A bibliography of original reports of measurements or calculations of electron, positron and photon cross sections and their ions is presented. A detailed index to the bibliography allows retrieval of cross section data for specific processes and atomic or molecular species. A comprehensive author index is included. The bibliography covers the period 1921 through calendar year

1974 but some references late in 1974 may not have been found and included. No references were found prior to 1921. GRA

N77-10884# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
VIBRATIONAL ENERGY DISTRIBUTION IN THE NO PRODUCED BY THE REACTION OF N(4S) WITH O2
Milo E. Whitson, Jr., Lane A. Darnton, and Robert J. McNeal 5 Apr. 1976 18 p refs
(Contract F04701-75-C-0076)
(AD-A023897; TR-0076(6970)-9; SAMSO-TR-76-80) Avail: NTIS HC A02/MF A01 CSCL 20/10

Infrared emission has been observed from NO(v = 2-7) produced by the reaction N(S(4)) + O2 to NO(v) + O. The apparent NO vibrational energy distribution is different from the distribution initially produced by the reaction owing to stepwise V-V quenching of NO(v) by collision with O2. A time to steady state flowing afterglow experiment has been used, along with data obtained elsewhere, to define the v dependence of this quenching process. Author (GRA)

N77-10885# United Technologies Research Center, East Hartford, Conn.
CALCULATION OF ENERGETICS OF SELECTED ATMOSPHERIC SYSTEMS. THEORETICAL METHODS Interim Report
H. Harvey Michels 30 Sep. 1976 63 p refs
(Contract F19628-73-C-0300; DNA Proj. NWED-QAXHD028)
(AD-A024308; AFCRL-TR-74-0491; SR-1) Avail: NTIS HC A04/MF A01 CSCL 20/10

A review of quantum mechanical methods for electronic structure calculations and radiative processes is given. This review article analyzes the several different approaches with illustrations and comments on their utility and accuracy. Author (GRA)

N77-10886# Air Force Academy, Colo. Research Lab.
EFFICIENT CHEMICAL PRODUCTION OF SINGLET DELTA OXYGEN Interim Report, 30 Jun. 1974 - 30 Sep. 1975
William E. McDermott and John T. Viola Dec. 1975 28 p refs
(AF Proj. 7903)
(AD-A024107; FJSRL-76-0005) Avail: NTIS HC A03/MF A01 CSCL 20/10

This interim report discusses progress made during the period 30 June 1974 - 30 September 1975 for the FJSRL work unit 7903-03-69, 'Chemiluminescent Gas Phase Reactions'. The objective of this study is to develop a chemical method for producing singlet delta oxygen in the gas phase and evaluating the singlet delta oxygen-I transfer chemical laser. A number of preliminary screening experiments were performed to identify the best method of production of singlet delta oxygen. The reaction system which produced the largest total yield of excited oxygen was found to be the Cl2-H2O2/NaOH heterogeneous reaction system. The liquid phase was coated on a large surface area glass substrate. As Cl2 is a potential deactivant of atomic iodine, the reactor design must allow for complete reaction of the gaseous chlorine. This implies that the sticking coefficient of the Cl2 must be significantly greater than the deactivation probability of the singlet delta oxygen with the substrate material. The sticking coefficient was measured by following the drop in pressure as Cl2 absorbed on a coated surface. This pressure drop was observed using a recording mercury manometer developed for this study. The sticking probability of Cl2 on the substrate material was found to be 1 in every 3 collisions as opposed to a deactivation probability for singlet delta oxygen of 1 in every 100,000 collisions. A preliminary run of a model reaction system was found to produce a singlet oxygen fraction greater than that observed in a microwave discharge. The total oxygen pressure was on the order of 0.2 torr. GRA

N77-10887# Cornell Univ., Ithaca, N.Y.
DYNAMICS OF THE CHEMISTRY OF ELECTRONICALLY EXCITED ATOMS IN DEFINED QUANTUM STATES Annual Summary Report, 1 Apr. 1975 - 31 Mar. 1976
John R. Wiesenfeld 28 Apr. 1976 46 p refs
(Contract N00014-75-C-0828; NR Proj. 394-010)
(AD-A023788) Avail: NTIS HC A03/MF A01 CSCL 07/5

The investigation of excited state chemistry has centered on the photodissociation of alkyl iodides and subsequent chemistry of the photofragments. In addition studies have been made of the deactivation of Br(14)doublet P(1/2) by the hydrogen isotopes, the results being compared to previously reported theoretical calculations. The role of E-V transfer in such quenching processes is also considered. GRA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation*.

N77-10888# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
COMBINED EFFECTS OF INTERNAL QUARK MOTION AND SU(6) BREAKING ON THE PROPERTIES OF THE BARYON GROUND STATE
A. LeYaouanc, L. Oliver, O. Pene, and J. C. Raynal [1976] 29 p refs
(LPTHE-76/7) Avail: NTIS HC A03/MF A01

Parameters are computed for mass differences within the octet, axial, and magnetic couplings of internal quark motion. Consequences of axial couplings and chiral configuration mixing are investigated. A good description is obtained for fine details of the baryon ground state. A.H.

N77-10889# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
GAMMA POLARISATION IN n+p YIELDS γ+d REACTION DUE TO WEAK PARITY EFFECTS
J. P. Leroy, J. Micheli, and D. Pignon [1975] 48 p Supersedes Report LPTHE-74/16
(LPTHE-75/32; LPTHE-74/16) Avail: NTIS HC A03/MF A01

The effect of parity violating weak interactions on the polarization of the photon in the thermal neutron capture is analyzed. The effect of various strong potentials is analyzed in detail in the non relativistic calculation. It is shown that, due to the short range of the weak interactions, the high momenta tail of the deuteron wave functions plays an important role. The effects of relativistic corrections are shown to be important for a precise quantitative calculation, but unable to explain the present disagreement between theory and experiment. Author

N77-10890*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HIGH ENERGY HEAVY ION ABSORPTION CROSS SECTION
John W. Wilson and Christopher M. Costner (Old Dominion Univ., Norfolk, Va.) Nov. 1976 16 p refs
(NASA-TM-X-73929) Avail: NTIS CSCL 20H

A simplified theory for heavy ion scattering shows good agreement with heavy ion absorption experiments. Theoretical implications concerning the complete coupled channel reactions equations are discussed. Author

N77-10891# General Atomic Co., San Diego, Calif.
CHARACTERISTICS OF A FIRST GENERATION COMMERCIAL FUSION POWER PLANT
C. C. Baker, C. R. Harder, and P. H. Sager, Jr. 11 Dec. 1975 30 p refs
(Contract E(04-3)-167)
(GA-A-13661) Avail: NTIS HC A03/MF A01

A brief survey was made to identify the major design parameters and features of a first generation commercial fusion plant using a noncircular Tokamak reactor. This study was made to provide a frame of reference for developing a conceptual design of a demonstration plant which is intended to demonstrate the principal features of a commercial plant on a scalable basis. Based on a review of size trends in the utility industry, the plant was sized to produce about 2,200 MW(e) gross output. Allowing for expected parasitic power requirements, the net station

output is approximately 1,800 MW(e). The plant is described in some detail. ERA

N77-10892# California Univ., Berkeley. Lawrence Berkeley Lab.
SUPERCONDUCTING DETECTOR MAGNETS: ALTERNATIVES AND CHOICES
M. A. Green Nov. 1975 33 p refs
(Contract W-7405-eng-48)
(LBL-4611) Avail: NTIS HC A03/MF A01

Detectors for colliding beam experiments require magnetic fields in order to detect and analyze charged particles. Often it is best to use a superconducting magnet to generate this field. Several kinds of superconducting magnets can potentially be used in the charged particle detectors. The solenoid appears to be the best type of superconducting magnet for this type of physics. Three kinds of superconducting solenoids can be used. The kind of solenoid magnet to be used in the experiment is dictated by the physics outside of the magnet coil. A low current density conventional solenoid and two types of high current density magnets which permit physics to be performed outside the magnet are discussed. ERA

N77-10893# Battelle Pacific Northwest Labs., Richland, Wash.
CONTROLLED THERMONUCLEAR REACTOR TECHNOLOGY Laboratory Report, Oct. - Dec. 1975
Jan. 1976 68 p refs
(Contract E(45-1)-1830)
(BNWL-1939-2) Avail: NTIS HC A04/MF A01

Survey calculations are being made on three blanket configurations for a conceptual hybrid design based on a Two Component Torus (TCT). The effects the plasma and associated radiation and emission will have upon the surfaces of the first wall are being studied. A variety of metal targets were prepared for neutron irradiation and were evaluated. Radioactive recoil sputtering ratios are summarized with complete results being prepared for separate publication. The development and testing of the ion blistering equipment is continuing with the design and installation of a special differential pumping stage. Analysis of the molybdenum specimens irradiated for the initial BCC ion correlation experiment is completed, and data from the participants have been compared. Graphite cloth and fibers irradiated in EBR-II are being evaluated for radiation damage effects. Helium effects are being studied on five alloys specified in CTR conceptual designs. ERA

N77-10894# Montpellier Univ. (France). Dept. de Physique Mathematique.
SU3, QUARK MODEL AND VECTOR DOMINANCE MODEL SOLUTIONS FOR THE RADIATIVE TRANSITIONS PROBLEM
G. Grunberg and F. M. Renard Jan. 1976 19 p refs
(PM/76/02) Avail: NTIS HC A02/MF A01

The recent failures of the quark model and the Vector Dominance Model VDM to explain the radiative transitions V leads to P + gamma are analyzed. Within the quark model several partial solutions exhibiting the octet dominance for the electromagnetic current are noticed. A genuine SU3 solution is also proposed relying on the omega-phi current-mixing. The VDM difficulties seem to be solved only by introducing higher vector mesons. Author (ESA)

N77-10895# Montpellier Univ. (France). Dept. de Physique Mathematique.
NONLINEAR EVOLUTION EQUATIONS ASSOCIATED WITH ENERGY DEPENDENT SCHROEDINGER POTENTIALS
M. Jaulent and I. Miodek Feb. 1976 11 p refs
(PM/76/03) Avail: NTIS HC A02/MF A01

The Inverse Scattering Transform is used to solve a class of nonlinear equations associated with the inverse problem for the one-dimensional Schroedinger equation with the energy-dependent potential V(k, x) = U(x) + kQ(x). Some essential details on the inverse problem are given together with properties of the scattering data and JOST solutions. The evolution equations are described and simple examples are given discussing the case Q(x) = 0 together with linearized forms of the evolution equations. Author (ESA)

N77-10896# Interuniversitair Reactor Instituut, Delft (Netherlands).
NEUTRON DEPOLARIZATION IN PRESSED FERRITE POWDERS [NEUTRONENDEPOLARISATIE IN GEPRESTE FERRIETPOEDERS]
M. T. Rekveldt and W. H. Kraan 7 Jan. 1976 13 p refs In DUTCH
(IRI-132-76-01) Avail: NTIS HC A02/MF A01

The neutron depolarization method was used to study magnetic domain structures in pressed ferrite powders consisting largely of monodomain particles. The values of sq(B sub s)delta, gamma sub i(i=x, y, z) and B were determined using neutron beams with wavelength 1.6 A for samples with thickness 2 to 2.5 mm or wavelength 4.0 A for 0.5 mm samples. B sub s is the spontaneous magnetic induction and B sub i the ith component of B sub s in a sample domain. Gamma sub i represents $<$sq(B sub i)$>$/sq(B sub s) and B is the average magnetic induction of the whole sample. Delta is the average time of transmission of the neutrons through the domain. The results of the measurements, which are represented graphically, are discussed. ESA

N77-10897# Battelle Pacific Northwest Labs., Richland, Wash.
SIGLEARN: A PROGRAM FOR SIMULTANEOUS LEAST-SQUARES FITTING OF THERMAL NEUTRON CROSS SECTIONS AND RELATED RATIOS
D. A. Kottwitz Feb. 1976 76 p refs Sponsored by Elec. Power Res. Inst.
(PB-254391/6; EPRI-NP-168) Avail: NTIS HC A05/MF A01 CSCL 20H

The computer program SIGLEARN was written to assist in the evaluation of the shapes of neutron cross sections fissile nuclides in the thermal energy region. Specifically, the program employs the method of nonlinear least squares to fit simultaneously up to 7 different types of data for a single nuclide. The program is a special adaption of the general-purpose nonlinear least squares program LEARN, which uses the Adler-Adler formulation for sigma f and sigma c, and the Breit-Wigner formula for sigma s. In addition to adjusting the free parameters and calculating the associated covariance matrix, the program performs a statistical evaluation of the quality of individual data points and relevance of parameter subsets. GRA

N77-10898# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
A FEASIBILITY STUDY OF A LINEAR LASER HEATED SOLENOID FUSION REACTOR Final Report
L. C. Steinhauer Feb. 1976 231 p refs Sponsored by Elec. Power Res. Inst.
(PB-254414/6; EPRI-ER-171) Avail: NTIS HC A11/MF A01 CSCL 18A

An assessment of the laser heated solenoid reactor concept in terms of its plasma physics, engineering design, and commercial feasibility is reported. Within the study many pertinent reactor aspects were treated including: physics of the laser plasma interaction; thermonuclear behavior of a slender plasma column; end-losses under reactor conditions; design of a modular first wall, a hybrid (both superconducting and normal) magnet, a large CO2 laser system; reactor blanket; electrical storage elements; neutronics; radiation damage, and tritium processing. Self-consistent reactor configurations were developed for both pure fusion and fusion-fission designs, with the latter designed both to produce power and/or fissile fuels for conventional fission reactors. GRA

74 OPTICS

Includes light phenomena.

N77-10899* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
WINDOW DEFECT PLANAR MAPPING TECHNIQUE Patent
Fred R. Minton (Rockwell Intern. Corp., Downey, Calif.) and Uel O. Minton, inventors (to NASA) (Rockwell Intern. Corp., Downey, Calif.) Issued 12 Oct. 1976 4 p Filed 14 Mar. 1975 Supersedes

N75-22119 (13 - 13, p 1576) Sponsored by NASA
(NASA-Case-MSC-19442-1; US-Patent-3,985,454; US-Patent-Appl-SN-558600; US-Patent-Class-356-237; US-Patent-Class-356-239) Avail: US Patent Office CSCL 20F

A method of planar mapping defects in a window having an edge surface and a planar surface. The method is comprised of steps for mounting the window on a support surface. Then a light sensitive paper is placed adjacent to the window surface. A light source is positioned adjacent to the window edge. The window is then illuminated with the source of light for a predetermined interval of time. Defects on the surface of the glass, as well as in the interior of the glass are detected by analyzing the developed light sensitive paper. The light source must be in the form of optical fibers or a light tube whose light transmitting ends are placed near the edge surface of the window. Official Gazette of the U.S. Patent Office

N77-10900# Sandia Labs., Albuquerque, N.Mex.
UTILIZATION OF FIBER OPTICS FOR RADIANT ENERGY TRANSFER
J. P. Hohimer Feb. 1976 42 p refs
(Contract AT(29-1)-789)
(SAND-75-0610) Avail: NTIS HC A03/MF A01

The utilization of fiber to collect and transfer the radiant energy emitted by a pulsed flashlamp or laser is considered. Such a system could be used for a variety of illumination and optical pumping applications including the optical initiation of high explosives. From an analysis of the electrical to optical energy conversion efficiencies of these optical sources and the light collection and transmission efficiencies of commercially available optical fibers, it is estimated that a 13.1 percent overall energy conversion efficiency could be attained at the output end of a one meter long optical fiber bundle using a critically damped xenon short-arc flashlamp as the optical source. The overall energy conversion efficiencies of the other source-fiber combinations considered are: 8.6 percent for a critically damped linear xenon flashlamp, 2.0 percent for a long-pulsed multimode Nd:YAG laser, 0.7 percent for a multimode Rhodamine 6G dye laser, and 0.5 percent for a Q-switched multimode Nd:YAG laser. Author (ERA)

N77-10901# Physics Lab. RVO-TNO, The Hague (Netherlands).
FREQUENCY DOUBLING OF LASER RADIATION WITH LITHIUM FORMATE CRYSTALS
A. vanHattem Oct. 1975 40 p refs In DUTCH; ENGLISH summary
(PHL-1975-40; TDCK-66907) Avail: NTIS HC A03/MF A01

The classical theory of frequency doubling was studied, and some optical properties of birefringent crystals are discussed. The efficiency of lithium formate crystals was measured for the conversion of laser light with a wavelength of 1.06 micron into 0.53 micron. This turned out to be four times larger than the efficiency of an ADP crystal of the same size. Author (ESA)

N77-10902# Naval Electronics Lab. Center, San Diego, Calif.
ALOFT FIBER OPTIC COMPONENT TESTS Final Report
G. Holma and T. Meador Jan. 1976 44 p refs
(AD-A024302; NELC/TD-460) Avail: NTIS HC A03/MF A01 CSCL 17/2

Tests were conducted on fiber optic cables, on fiber optic pressure-bulkhead connectors, and on an electrooptical data link to determine if these components would survive the environments of the A-7 aircraft. Components performed as expected and were shown to withstand the A-7 environments. Author (GRA)

N77-10903# Naval Research Lab., Washington, D.C.
THEORETICAL DEVELOPMENT OF THIRD-ORDER SUSCEPTIBILITY AS RELATED TO COHERENT ANTISTOKES RAMAN SPECTROSCOPY (CARS) Final Report
R. N. DeWitt, A. B. Harvey, and W. M. Tolles Apr. 1976 67 p refs
(NRL Proj. C07-01)
(AD-A024164; NRL-MR-3260) Avail: NTIS HC A04/MF A01 CSCL 20/6

The basic theory for coherent anti-Stokes Raman spectroscopy has been developed by two methods: a classical approach and a quantum mechanical development. Standard methods of perturbation theory, Maxwell's equation, harmonic oscillator approximation, and density matrix theory are applied to the third-order nonlinear effect of generating anti-Stokes photons from the mixing of two intense laser beams. Each mathematical step has been explicitly included in the derivations and comparisons between the expressions obtained here and those published in the literature are made. Where possible, clarification with respect to differences of factors of '2' or '3' which appear in various references have been included. GRA

N77-10904# Hughes Research Labs., Malibu, Calif.
FABRICATION OF ZnSx IR WINDOWS BY PHYSICAL VAPOR TRANSPORT TECHNIQUE Final Technical Report, 15 Nov. 1973 - 15 Nov. 1975
A. L. Gentile, N. R. Kyle, and E. L. Kern Jan. 1976 64 p refs
(Contract F33615-74-C-1022; AF Proj. 7371)
(AD-A024533; AFML-TR-75-219) Avail: NTIS HC A04/MF A01 CSCL 20/6

We conducted a developmental investigation directed toward the fabrication of ZnSe, ZnS and mixed crystal ZnS(1-x)Se(x) windows by a physical vapor transport (PVT) technique. The PVT process utilizes the vapor-solid relationship of the II-VI compounds to transport material from a solid compact source at an elevated temperature (approximately 1,000 C for ZnSe) to a uniformly heated substrate at a highly lower temperature (2 to 5 C lower than source) via gaseous phase under conditions of dynamic vacuum which prevent pressure buildup inside the chamber, i.e., maintains the total pressure at a minimum (P min). Primarily most of our effort went into development of a laboratory scale (up to 3.25 in. diameter) apparatus using ZnSe. In this size, we also studied some mixed crystal specimens of composition Zn(0.9) using an intimate mechanical mixture of 83 at.% ZnS, 17 at.% ZnSe as the source material; the final sample showed uniformity both axially and radially within the analytical limits of the electron microprobe (+ or -1%). This composition showed a marked decrease in the 10 microns absorption typically shown by pure ZnS indicating the possibility of using sulfide-rich mixed-crystal compositions for application as rain erosion-resistant common-aperture airborne windows in the multispectral range 0.5 to 14 microns. GRA

N77-10905# Optical Science Consultants, Yorba Linda, Calif.
PREDICTION COMPENSATED IMAGING THEORY Interim Report, 18 Aug. 1975 - 15 Feb. 1976
David L. Fried Apr. 1976 111 p refs
(Contract F30602-76-C-0005; ARPA Order 2646)
(AD-A024393; DR-059; RADC-TR-76-103) Avail: NTIS HC A06/MF A01 CSCL 20/6

This report presents results on several subjects related to predetection compensated imaging. In Chapter I, it treats the relationship between noise in phase difference measurements and the resultant noise in the estimated wavefront. In Chapter II, results are presented for use in reduction and interpretation of the AMOS site characterization measurements. Chapter III presents results on the subject of intensity isoplanatism. Chapter IV is concerned with the accuracy with which the achieved OTF of a predetection compensated image can be estimated. GRA

N77-10906# Frankford Arsenal, Philadelphia, Pa.
ION BEAM SPUTTERING OF INFRARED OPTICAL MATERIALS
J. D. Lester, H. Gelles, and C. Bianchi Aug. 1975 34 p refs
(AD-A024649; FA-TR-75069) Avail: NTIS HC A03/MF A01 CSCL 20/6

The sputter yield and morphological characteristics of materials commonly employed for infrared optical elements is described. A method to utilize a numerically controlled low energy ion beam to figure and polish infrared optical elements is presented. This method is capable of forming highly accurate large aperture optical elements without degrading optical performance by the introduction of trace impurities. Author (GRA)

N77-10907# California Univ., Los Angeles. Dept. of Materials.
SYNTHESIS OF NEW OR IMPROVED OPTICAL AND

ELECTRICAL MATERIALS Final Report, 1 Apr. 1972 - 31 Dec. 1974
R. F. Bunshah, R. O. Dillon, and H. A. Beale Nov. 1975 57 p refs
(Contract N00123-72-C-2064)
(AD-A023903; UCLA-ENG-7590) Avail: NTIS HC A04/MF A01 CSCL 20/5

This investigation consisted of four parts. In part one, the deposition of the small bandgap material GaxIn1-xSB was explored. Experimental parameters were established for the deposition of polycrystalline films of various alloys in this system using single source evaporation. In the second part, the deposition of the large-bandgap materials A1N and A1Sb was examined. The third and fourth parts of the investigation were concerned with the deposition of laser mirror materials and the synthesis of TiO2 (rutile) films. Author (GRA)

N77-10908# National Bureau of Standards, Boulder, Colo. Time and Frequency Div.
APPLICATION OF INFRARED FREQUENCY SYNTHESIS TECHNIQUES WITH METAL-INSULATOR-METAL DIODES TO THE SPIN FLIP RAMAN LASER
J. S. Wells, G. E. Streit, and F. R. Petersen Apr. 1976 17 p refs
(PB-254066/4; NBS-TN-680) Avail: NTIS HC A02/MF A01 CSCL 20F

Infrared frequency synthesis techniques with a metal-insulator-metal diode have been extended to include the measurement of the frequency of a spin flip Raman Laser (SFEL). As a result of the extension, spectroscopy in the 5.3 micrometer region can be put on a frequency rather than a wave-length metrology basis. Additional observations with the diode are in qualitative agreement with recent work relating to non-linear tuning over axial SFRL modes. GRA

N77-10301*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CUBIC SPLINE REFLECTANCE ESTIMATES USING THE VIKING LANDER CAMERA MULTISPECTRAL DATA
Stephen K. Park and Friedrich O. Huck *In its* Advan. in Eng. Sci., Vol. 2 1976 p 769-778 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01 CSCL 20F

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N77-10909*# Transemantics, Inc., Washington, D.C.
ELECTRON DENSITY DISTRIBUTION IN MAGNETIZED HYDROGEN ARC PLASMAS WITH THE ION TEMPERATURE DEVIATING FROM THE ELECTRON TEMPERATURE
G. Venus Washington NASA Aug. 1976 21 p refs Transl. into ENGLISH from Z. fuer Physik, v. 259, no. 5, 1973 p 437-450
(Contract NASw-2792)
(NASA-TT-F-17141) Avail: NTIS HC A02/MF A01 CSCL 20I

The radial distribution of the electron density in hydrogen arc plasmas in a strong axial magnetic field is determined by measuring the rotation of the polarization plane of linearly polarized light (Faraday effect). As expected, it is found that the electron density decreases towards the discharge axis, i. e. with increasing temperature, but again rises near the axis. This increase is due to a thermomagnetic effect, the Nernst effect, in cases where the ion temperature is much lower than the electron temperature. Author

N77-10910*# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
THEORETICAL INVESTIGATIONS OF PLASMA PROCESSES Annual Report, Oct. 1975 - Oct. 1976
H. E. Wilhelm and S. H. Hong 15 Oct. 1976 86 p
(Grant NGR-06-002-147)
(NASA-CR-136079) Avail: NTIS HC A05/MF A01 CSCL 20I

System analyses are presented for electrically sustained, collision dominated plasma centrifuges, in which the plasma rotates under the influence of the Lorentz forces resulting from the interaction of the current density fields with an external magnetic field. It is shown that gas discharge centrifuges are technically feasible in which the plasma rotates at speeds up to 1 million cm/sec. The associated centrifugal forces produce a significant spatial isotope separation, which is somewhat perturbed in the viscous boundary layers at the centrifuge walls. The isotope separation effect is the more pronounced. The induced magnetic fields have negligible influence on the plasma rotation if the Hall coefficient is small. In the technical realization of collision dominated plasma centrifuges, a trade-off has to be made between power density and speeds of rotation. The diffusion of sputtered atoms to system surfaces of ion propulsion systems and the deposition of the atoms are treated theoretically by means of a simple model which permits an analytical solution. The problem leads to an inhomogeneous integral equation. Author

N77-10911# Institute of Plasma Physics, Prague (Czechoslovakia).
SOME PROPERTIES OF THE GAS DISCHARGE IN A MAGNETRON GEOMETRY
K. Kolacek and S. Korbel Jan. 1976 21 p refs
(IPPCZ-209) Avail: NTIS HC A02/MF A01

The discharge in a magnetron geometry was experimentally investigated. In pressures less than 10 to the 2nd power torr a high-voltage discharge (similar to corona discharge) burns, which discontinuously turns into glow discharge when the pressure is rising. Magnetic field changes the glow discharge in a similar way as the rising of pressure does (the cathode regions are getting shorter, etc.). The pressures and magnetic fields were discovered in which the positive column occupies 3/4 of the discharge space (gap distance 4 cm) and where an electric field 100 V/cm could be measured. Author

N77-10912*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEST PARTICLE PROPAGATION IN MAGNETOSTATIC TURBULENCE. 1. FAILURE OF THE DIFFUSION APPROXIMATION
A. J. Klimas, G. Sandri, J. D. Scudder, and D. R. Howell Sep. 1976 66 p refs Submitted for publication
(NASA-TM-X-71208; X-692-76-207) Avail: NTIS HC A04/MF A01 CSCL 20I

The equation which governs the quasi-linear approximation to the ensemble and gyro-phase averaged one-body probability distribution function is constructed from first principles. This derived equation is subjected to a thorough investigation in order to calculate the possible limitations of the quasi-linear approximation. It is shown that the reduction of this equation to a standard diffusion equation in the Markovian limit can be accomplished through the application of the adiabatic approximation. A numerical solution of the standard diffusion equation in the Markovian limit is obtained for the narrow parallel beam injection. Comparison of the diabatic and adiabatic results explicitly demonstrates the failure of the Markovian description of the probability distribution function. Through the use of a linear time-scale extension the failure of the adiabatic approximation, which leads to the Markovian limit, is shown to be due to mixing of the relaxation and interaction time scales in the presence of the strong mean field. Author

N77-10913# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
THERMODYNAMIC PROPERTIES AND HALL CURRENTS IN MPD ACCELERATORS
Robert P. Collier and David S. Scott 19 Dec. 1975 39 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal in Feb. 1977
Avail: NTIS HC A03/MF A01

The thermodynamic properties and Hall currents in the arc region of MPD accelerators are investigated analytically and experimentally. Expressions for the current density components in the accelerator are developed from a generalized Ohm's law. Simplifying assumptions applicable to a large class of accelerators are made. A nonequilibrium ionization equation is used with the

simplified component equations to calculate the Hall current density and the total Hall current in the accelerator arc region as functions of applied current and assumed electron temperature and density profiles. Spectral intensities are measured and used to calculate electron temperature and density profiles in an experimental accelerator. For fixed operating conditions, the temperature is uniform across the arc region, but the electron density is a strong function of radial position. Author

N77-10914# Boston Coll., Chestnut Hill, Mass.
MICROINSTABILITIES IN COMPLEX MAGNETIC FIELD GEOMETRIES AND HIGH-BETA SHEARED SHEATH STRUCTURE Progress Report, 1 Jun. 1975 - 27 Feb. 1976
P. Bakshi and G. Kalman Feb. 1976 20 p refs
(Contract E(11-1)-2714)
(COO-2714-1) Avail: NTIS HC A02/MF A01

A new approach for the solution of the Vlasov equation for complex magnetic field geometries has been developed using operator techniques. The general approach is illustrated by determining the perturbed distribution function and density operator for the problem of shear stabilization of drift waves for transverse and arbitrary directions of propagation. The ensuing corrections to stability criteria of current theories are obtained for certain domains of physical parameters. The adiabatic and non-adiabatic behavior of a harmonic oscillator has been studied using operator methods. High-beta, high shear plasma sheath configurations have been studied with the full ion dynamics taken into account and electrons treated in the zero and first order approximation, in the ratio of the electron Larmor radius to the scale length. The resulting sheath structure equation in the lowest order approximation has been solved for certain entering ion distributions, and prepared for computer analysis for others. In this approximation the electron current parallel to magnetic field lines has to be assumed suppressed or predetermined. ERA

N77-10915# University of South Florida, Tampa. Dept. of Physics.
ENHANCED ION HEATING BY SPATIAL MAGNETIC FIELD VARIATION, A CATALYTIC HEATING SCHEME. CONTINUATION OF INVESTIGATION OF TURBULENT HEATING SCHEMES
W. D. Jones and N. L. Oleson 26 Mar. 1976 14 p refs
(Contract AT(40-1)-4338)
(ORO-4338-9) Avail: NTIS HC A02/MF A01

A tailored periodic spatial magnetic field variation superimposed on the magnetically supported plasma column of a linear turbulent heating device leads to electron trapping which, via trapped electron modes and other instabilities, increases the level of low frequency turbulence. Impressive increases in ion heating have been observed for only modest strengths of the superimposed field. ERA

N77-10916# Princeton Univ., N.J. Plasma Physics Lab.
ENHANCED PENETRATION OF NEUTRAL-BEAM INJECTED IONS BY VERTICALLY ASYMMETRIC TOROIDAL-FIELD RIPPLE
D. L. Jassby and R. J. Goldston Feb. 1976 30 p refs
(Contract E(11-1)-3073)
(MATT-1206) Avail: NTIS HC A03/MF A01

The penetration length of energetic neutral-atom beams injected into a Tokamak plasma is effectively increased by a large factor, if the beams are injected vertically and the toroidal magnetic field has significant ripple below the midplane. The energetic ions resulting from ionization of the fast neutrals are ripple trapped and drift upward to the midplane region. The ripple must decrease substantially in the region above the midplane, so that the ions can be captured and retained in the central plasma region during their entire slowing-down period. Orbit calculations with a Monte Carlo guiding-center code demonstrate the feasibility of this trapping process. ERA

N77-10917# Princeton Univ., N.J. Plasma Physics Lab.
PLASMA HEATING BY INDUCED SCATTERING OF MAGNETOSONIC WAVES
L. Chen Feb. 1976 17 p refs
(Contract E(11-1)-3073)
(MATT-1210) Avail: NTIS HC A02/MF A01

It is shown that, in a plasma with beta less than or equal to 1 and T/sub e/T/sub i/less than or equal to 4, parametric excitations of magnetosonic waves through nonlinear ion Landau damping may be utilized to heat both electrons and ions. Nonlinear saturation and associated plasma heating rate of this decay process are also considered. ERA

N77-10918# California Univ., Irvine.
STUDY OF PLASMA HEATING BY INTENSE RELATIVISTIC ELECTRON BEAMS
N. Rostoker and N. Rynn Oct. 1975 65 p refs
(Contract AT(04-3)-34)
(UCI-34-P-20-7X3) Avail: NTIS HC A04/MF A01

The theoretical analysis of rotating beam - plasma coupling processes, and of beam stability, is described. Studies on beam and plasma diagnostics are outlined. The Vlasov instability of a rotating beam is discussed. ERA

N77-10919# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abteilung Theoretische Gasdynamik.
WEAK DISTURBANCES OF MAGNETOGASDYNAMICS DISCONTINUITIES
Dietrich Rues 30 Jan. 1976 41 p refs In GERMAN; ENGLISH summary Report will also be announced as translation
(DLR-FB-76-11) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 20,20

The influence of weak disturbances on magnetogasdynamic discontinuities was investigated. In particular, the important case of magnetogasdynamic shock waves was studied. After linearization of the magnetogasdynamic differential equations, the flow fields before and behind the discontinuity were matched by means of the linearized Rankine-Hugoniot-relations. By specialization of these general equations the different cases up to the one-dimensional gasdynamic shock waves are obtained. As an example the disturbances for gasdynamic shock waves were calculated. A disturbance in front of the shock wave generates entropy when crossing the shock wave. Author (ESA)

N77-10920# Battelle Columbus Labs., Ohio.
AN INVESTIGATION OF MECHANISMS OF INITIATION OF LASER-SUPPORTED ABSORPTION (LSA) WAVES Final Report, 23 Apr. 1973 - 15 Aug. 1975
C. T. Walters, R. H. Barnes, and R. E. Beverly, III Sep. 1975 129 p refs
(Contract DAAH01-73-C-0776; ARPA Order 2113)
(AD-A024496) Avail: NTIS HC A07/MF A01 CSCL 20/9

This report presents results of experimental effort undertaken in the study of the initiation of laser-supported absorption (LSA) waves on solid surfaces irradiated in air with pulsed laser radiation. LSA waves may be classified as either supersonic, so-called laser-supported detonation (LSD) waves, or as subsonic, so-called laser-supported combustion (LSC) waves. In either case, a hot-air plasma (1-2 eV) is formed which propagates back up in the laser beam away from the target surface and absorbs most of the laser-beam energy. The objective of this study was to provide an improved understanding of the process of LSA wave initiation. During the first year of study, experiments were directed toward understanding the mechanisms of initiation of LSD waves produced on practical aluminum surfaces in air with the Battelle 80-joule TEA CO2 laser. During the second year of research, the universality of the electron emission mechanism was investigated in experimental studies of initiation at the 10.6 micrometer wavelength on additional metallic materials having practical surfaces, including tungsten, lead, copper, and zinc. GRA

N77-10921# Battelle Columbus Labs., Ohio.
AN INVESTIGATION OF MECHANISMS OF INITIATION OF LASER SUPPORTED ABSORPTION (LSA) WAVES Semiannual Report, 15 Jul. 1974 - 14 Jan. 1975
C. T. Walters, R. H. Barnes, and R. E. Beverly, III Jan. 1975 52 p refs
(Contract DAAH01-73-C-0776; ARPA Order 2113)
(AD-A024550) Avail: NTIS HC A04/MF A01 CSCL 20/9

Additional experimental results of a study of LSA-wave initiation processes are reported. The first measurements of delay time to initiation on nonmetallic materials are presented. In metallic studies, target emission of electrons from aluminum

2024, lead, and tungsten surfaces were recorded at atmospheric pressure prior to LSA-wave initiation. No surface damage was observed on the tungsten surface at 2000X in SEM inspections after irradiation, while lead and aluminum exhibited defect-oriented damage. Time-resolved spectroscopy experiments with aluminum 2024 revealed a dramatic drop in the ionized aluminum vapor emissions above the air pressure threshold for LSA-wave initiation (5-10 torr at 3.2 x 10 to the 8th power watt/cm squared).GRA

N77-10922# Aerospace Corp., El Segundo, Calif.
PARTICLE MOTION AND DIFFUSION IN GEOMETRIC MIRRORS Interim Report
Michael Schulz 24 Mar. 1976 13 p refs
(Contract F04701-75-C-0076)
(AD-A024223; TR-0076(6260-20)-12; SAMSO-TR-76-73) Avail: NTIS HC A02/MF A01 CSCL 20/9

Expressions are derived for the full bounce period and second adiabatic invariant of a charged particle trapped in a geometric mirror (which confines plasma by means of a magnetic surface layer). Fieldfree regions of double-conical and ellipsoidal shape are treated explicitly as special cases, and global diffusion equations are derived for these cases by bounce-averaging the equation for local pitch-angle diffusion caused by collisions with the coexisting neutral gas. Author (GRA)

N77-10923# Michigan Univ., Ann Arbor. Dept. of Mathematics.
MAGNETOHYDRODYNAMICS, PLASMAS, AND NONLINEAR OSCILLATIONS Interim Report, 1 Sep. 1974 - 31 Aug. 1975
Lamberto Cesari Sep. 1975 10 p
(Grant AF-AFOSR-2122-71; AF Proj. 9749)
(AD-A024417; AFOSR-76-0525TR) Avail: NTIS HC A02/MF A01 CSCL 20/9

This report includes a list of papers completed and published, a description of the activities of each of the investigators, and a discussion of some of the most significant results obtained.GRA

N77-10924# California Univ., Livermore. Lawrence Livermore Lab.
ELECTROMAGNETIC BRAKE
H. L. Sahlin Jan. 1976 14 p refs Presented at the 1976 Annual Meeting on Theoretical Aspects of Controlled Thermonuclear Research, Madison, Wis., 7-9 Apr. 1976
(Contract W-7405-eng-48)
(UCRL-77892; Conf-760419-1) Avail: NTIS HC A02/MF A01

The interaction of a relativistic electron beam with a laser pulse in a target plasma is theoretically described. An analysis is given for the stimulated bremsstrahlung effect. ERA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N77-10925*# Kanner (Leo) Associates, Redwood City, Calif.
MEASUREMENT OF THE DIFFERENTIAL ELASTIC SCATTERING OF He ATOMS AND THE DETERMINATION OF THE POTENTIALS OF REPULSION INTERACTION
V. B. Leonas and A. V. Sermyagin Washington NASA Oct. 1976 18 p refs Transl. into ENGLISH of "Izmereniya differentsialnogo uprugogo rasseyaniya atomov He i opredeleniye potentsialov ottalkivatelnogo vzaimodeystviya", Rept-Po-261 USSR Acad. Sci., Inst. of Space Res., Moscow, 1976 p 1-14
(Contract NASw-2790)
(NASA-TT-F-17268) Avail: NTIS HC A02/MF A01 CSCL 20L

Measurements are reported on differential elastic scattering for the systems: He-He, He-O(+), and He-H2. From a comparison of the observed scattering with scattering values calculated from available theoretical potentials of interaction, conclusions are drawn as to their relative reliability. Author

N77-10926# Laboratoire de Physique Theorique et Particules Elementaires, Orsay (France).
THE NUMBER OF BOUND STATES OF SINGULAR OSCILLATING POTENTIALS
K. Chadan Apr. 1976 10 p refs
(LPTPHE-76/10) Avail: NTIS HC A02/MF A01

An upper bound for the number of bound states of a short range and spherically symmetric potential is given. Author

N77-10927# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
SCATTERING AND LOCAL ABSORPTION FOR THE SCHROEDINGER OPERATOR
M. Combescure and J. Ginibre Feb. 1976 32 p refs
(LPTHE-76/4) Avail: NTIS HC A03/MF A01

For the Schroedinger operator H = - delta + V with potential V singular on a compact set epsilon of measure zero but sufficiently regular outside, the subspace of absolute continuity can be decomposed as the direct sum of a subspace of scattering states and a subspace of states locally absorbed on epsilon. This was proved by Pearson for dimension n = 3 and V belongs to L squared + L to infinity away from epsilon. We extend this result to arbitrary dimension and to potentials that are only locally strictly delta-semibounded away from epsilon. In particular they may be strongly oscillating away from epsilon and have arbitrary behavior at infinity. Author

N77-10928*# Texas A&M Univ., College Station. Dept. of Electrical Engineering.
EFFECT OF INTERFACIAL OXIDE LAYERS ON THE CURRENT-VOLTAGE CHARACTERISTICS OF Al-Si CONTACTS
W. A. Porter and D. L. Parker 1976 66 p refs
(Contract NAS8-26379)
(NASA-CR-150044) Avail: NTIS HC A04/MF A01 CSCL 20L

Aluminum-silicon contacts with very thin interfacial oxide layers and various surface impurity concentrations are studied for both n and p-type silicon. To determine the surface impurity concentrations on p(+)-p and n(+)-n structures, a modified C-V technique was utilized. Effects of interfacial oxide layers and surface impurity concentrations on current-voltage characteristics are discussed based on the energy band diagrams from the conductance-voltage plots. The interfacial oxide and aluminum layer causes image contrasts on X-ray topographs. Author

N77-10929# Sandia Labs., Albuquerque, N.Mex.
SIZING SINGLE CRYSTAL SAPPHIRE
D. W. Bushmire Mar. 1976 17 p refs
(Contract AT(29-1)-789)
(SAND-75-0614) Avail: NTIS HC A02/MF A01

The work done in developing a satisfactory method of sizing single crystal sapphire is described. The results of sizing using grinding wheels, wire saws, and laser scribers are given. It was concluded that laser scribing is a viable method of sizing if the sapphire is grown parallel to the r plane. This takes advantage of the easy crystal cleavage planes and reduces the risk of edge chipping and nonperpendicular breaking. ERA

N77-10930# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
SPECIFIC HEAT OF DILUTE TRANSITION ALLOYS Ph.D. Thesis - Strasbourg Univ.
Rene Caudron 1976 51 p refs In FRENCH; ENGLISH summary Report will also be announced as translation
(ONERA-P-1976-2) Avail: NTIS HC A04/MF A01

The electronic specific heat of dilute alloys of transition metals in nickel was studied: a large increase of electronic specific heat appears when the virtual bound level extracted from the d vector band by the impurity potential is present at the Fermi level. Dilute solutions of carbon in NiFe and NiCo alloys were examined. Measurements suggest that the main part of the screening is ensured by spin vector electrons for strong ferromagnetic alloys. When the matrices become weakly ferromagnetic, the results are interpreted by filling of the holes in the vector band which are present at the Fermi level. The magnetic specific heat of dilute alloys of iron in molybdenum was also studied. These alloys are spin glasses, in spite of the

fact that their matrix is a transition metal. They can be distinguished from the best known spin glasses, which have a noble metal matrix, by a larger value of the interaction parameter and by abnormally low temperatures for the susceptibility maximum. The comparison between the high and low temperature behavior of the specific heat provides a complementary indication of the validity of the Blandin-Marshall model, though based on an Ising model. Author (ESA)

N77-10931# Boeing Aerospace Co., Seattle, Wash.
SERVICE FOR DEVICE SURFACE ANALYSIS Interim Report, May 1974 - Sep. 1975
Louis L. Sivo and Robert B. Greegor 10 Sep. 1975 145 p refs
(Contract N00014-74-C-0306; DNA Proj. NWED-QAXTD043) (AD-A024333; D180-19044-1) Avail: NTIS HC A07/MF A01 CSCL 20/12

The primary scope of the program was the assessment of the total dose sensitivities of various devices (primarily MOS capacitors and bipolar transistors) as a function of oxide processing. In measuring the total dose damage, gain and leakage current measurements were used for the bipolar devices while quasi-static and 1 MHz C-V measurements were used for the MOS capacitors. The oxides studied were representative of bipolar technology and they were very sensitive to total dose (primarily in the creation of new interface states). Oxide processing dependence of the radiation response was strong for both the oxide charges and the interface states. Both the pre-existing oxide and the last oxidation step were instrumental in controlling the radiation response of the resulting oxide structure. Wet HCl oxidation increased the total dose sensitivity (primarily by increasing the charge accumulation, its effect on the interface states was inconsistent). GRA

N77-10237*# Aerospace Corp., El Segundo, Calif.
MICROMECHANICS OF SLIP BANDS ON A FREE SURFACE
S. R. Lin and T. H. Lin (Univ. Calif., Los Angeles) *In* NASA. Langley Res. Center Adv. in Eng. Sci., Vol. 1 1976 p 67-75 refs (For primary document see N77-10230 01-31)
(Grant NSF ENG-74-03809)
Avail: NTIS HC A02/MF A01

N77-10259*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
HIGHER-ORDER EFFECTS OF INITIAL DEFORMATION ON THE VIBRATIONS OF CRYSTAL PLATES
Xanthippi Markenscoff *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 1 1976 p 301-308 refs Submitted for publication (For primary document see N77-10230 01-31)
(Grant NSF ENG-75-11875)
Avail: NTIS HC A16/MF A01

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N77-10932# National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
BASIC CONCEPTS OF RATIONAL CONTINUUM MECHANICS
Rudolf Roesel Nov. 1975 22 p ref
(CSIR-WISK-190) Avail: NTIS HC A02/MF A01

The fundamental mathematical framework on which the theory of mechanics rests is demonstrated. This lecture is essentially a summary of the main ideas of Walter Noll. Author

N77-10933*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REVISED INTERNATIONAL REPRESENTATIONS FOR THE VISCOSITY OF WATER AND STEAM AND NEW REPRESENTATIONS FOR THE SURFACE TENSION OF WATER
R. C. Hendricks, R. B. McClintock (GE Co., Schenectady, N. Y.), and G. J. Silvestri (Westinghouse Elec. Corp., Philadelphia, Pa.) 1976 53 p refs Proposed for presentation at Winter Ann. Meeting of the Am. Soc. of Mech. Engr., New York, 5-10 Dec. 1976 Revised
(NASA-TM-X-73483; E-8706) Avail: NTIS HC A04/MF A01 CSCL 20M

A skeleton table and formulation for viscosity is presented. The formulation is valid from the triple point to 1100 K (2000 R) and pressures to 100 MPa (15,000 psia). Comparisons are made between the calculated and the skeletal table values, and also between the new values and those in the 1967 ASME Steam Tables. A set of figures and tables in both English and S. I. units are presented to replace those in the steam tables. Sources for computer programs are given. Author

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N77-10297*# Stevens Inst. of Tech., Hoboken, N.J.
APPLIED GROUP THEORY APPLICATIONS IN THE ENGINEERING (PHYSICAL, CHEMICAL, AND MEDICAL), BIOLOGICAL, SOCIAL, AND BEHAVIORAL SCIENCES AND IN THE FINE ARTS
S. F. Borg *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 731-740 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N77-10934# Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
AN APPLICATION OF SIMULATION NETWORKING TECHNIQUES IN OPERATIONAL TEST DESIGN AND EVALUATION M.S. Thesis
Elwyn LeRoy Brown May 1975 171 p refs
(Contract DAAG39-75-C-0097)
(AD-A024204) Avail: NTIS HC A08/MF A01 CSCL 15/5

The purpose of this thesis may be summarized as follows: Review and analyze network simulation as a viable risk analysis technique for operational testing; compare two existing computer programs available to conduct network simulation; and apply network simulation to an operational test design illustrating the criticality and sensitivity of test design data. GRA

N77-10109*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN APPROACH TO IMPROVE MANAGEMENT VISIBILITY WITHIN THE PROCUREMENT AND FINANCIAL GROUP AT GOLDSTONE
F. R. Maiocco and J. B. Rozek *In its* The Deep Space Network 15 Oct. 1976 p 171-179 ref (For primary document see N77-10091 01-12)
Avail: NTIS HC A10/MF A01 CSCL 05A

N77-10302*# Texas Univ., Austin.
DATA MANAGEMENT IN ENGINEERING
J. C. Browne *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 2 1976 p 779-789 refs (For primary document see N77-10265 01-31)
Avail: NTIS HC A20/MF A01

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N77-10935* + National Aeronautics and Space Administration, Washington, D.C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY, SECTION 2, INDEXES
Jul. 1976 518 p
(NASA-SP-7039(09)) Avail: NTIS HC $5.00 CSCL 05B

There are 200 patents and applications for patent introduced into the NASA scientific and technical information system during the period January 1976 through June 1976 presented. Each entry consists of a citation, an abstract, and, in most cases, a key illustration selected from the patent or application for patent. There are 2,994 patent and application for patent citations covering the period May 1969 through June 1976 listed. Subject, inventor, source, number, and accession number indexes are set forth. Author

N77-10936# European Space Agency, Paris (France).
DATABASE SYSTEMS. INVESTIGATION REPORTS. VOLUME 2: ADABAS, PART 1
Apr. 1976 264 p Transl. into ENGLISH of "Datenbanksysteme. Erfahrungsber. Heft 2: ADABAS, Teil 1", Ges. fuer Mat. u. Datenverarbeitung, Bonn Report, Apr. 1975
(ESA-TT-280-Vol-2-Pt-1) Avail: NTIS HC A12/MF A01

The ADABAS adaptable data base management system is described in detail. The description covers features and properties, system environment, and expenditure. ESA

N77-10937# European Space Agency, Paris (France).
DATABASE SYSTEMS. INVESTIGATION REPORTS. VOLUME 2: ADABAS, PART 2
Apr. 1976 129 p Transl. into ENGLISH of "Datenbanksysteme. Erfahrungsber. Heft 2: ADABAS, Teil 2", Ges. fuer Mat. u. Datenverarbeitung, Bonn Report, Apr. 1975
(ESA-TT-281-Vol-2-Pt-2) Avail: NTIS HC A07/MF A01

The ESRO (ESA) electronic components data base was selected for the investigation of the ADABAS adaptable data base system. The data base fulfills two requirements: possibility of relating individual investigations associated with special performances of the system to each other, and presentation of relevant search inquiries for the assessment of the search functions. ESA

N77-10938# Ohio Univ., Athens. Dept. of Electrical Engineering.
VIDEO DATA COMPRESSION STUDY FOR REMOTE SENSORS Final Report, 15 May 1973 - 30 Jun. 1975
Joseph E. Essman, Dan Quyen Hua, and George Papacostas
Feb. 1976 348 p refs
(Contract F33615-73-C-1233; AF Proj. 7662)
(AD-A023845; AFAL-TR-75-173) Avail: NTIS HC A15/MF A01 CSCL 09/4

This report summarizes a 24 month investigation on video data reduction method applicable to RPV's. Areas investigated included interframe reduction, two-dimensional transform and hybrid coding using Walsh and Fourier transforms and DPCM coding, and adaptive techniques using Hadamard transforms. Included are numerous photographs of low altitude target runs showing the effects of channel errors and coding degradation. A bibliography of up to date references on image processing is also included. GRA

N77-10939# Hamline Univ., St. Paul, Minn.
DEVELOPMENT AND IMPLEMENTATION OF A CURRICULUM-BASED INFORMATION SUPPORT SYSTEM FOR HAMLINE UNIVERSITY
Anne S. Mavor and W. S. Vaughan, Jr. Jan. 1974 118 p Prepared by Whittenburg, Vaughan Associates, Inc., Landover, Md.
(Grant NSF GN-873)
(PB-252428/8) Avail: NTIS HC A06/MF A01 CSCL 05B

The central features of the system are contained in the role of the information specialist who serves as a link between the information requirements generated by the curriculum and the available information resources. The specialists work with professors to construct a task model of each supported course. These task models are used both as the basis for deriving information needs and as a reference for the evaluation of products and services provided. GRA

N77-10940# National Library of Medicine, Bethesda, Md.
ON-LINE SERVICES REFERENCE MANUAL (INCLUDING UPDATE 1, JULY 1975, AND UPDATE 2, MARCH 1976)
Mar. 1976 381 p
(PB-253557/3; NLM-MED-76-02) Avail: NTIS HC A17/MF A01 CSCL 06E

A comprehensive manual for the operation of the various NLM on-line data bases is presented. It contains specific information on modes of accessing these data bases, the commands which may be used, techniques for searching them, and a number of appendices. Instructions are included on the use of MEDLINE, SDILINE, BACKFILES, OFFSEARCH, CATLINE, NAME AUTHORITY FILE, SERLINE, JOURNAL AUTHORITY FILE, VOCABULARY FILE, TOXLINE, CHEMLINE, CANCERLINE, CANCERPROJ, AVLINE, and EPILEPSY. GRA

N77-10941# Federal Energy Administration, Washington, D.C. Office of Policy and Analysis.
DIRECTORY OF FEDERAL ENERGY DATA SOURCES: COMPUTER PRODUCTS AND RECURRING PUBLICATIONS
May 1976 84 p
(PB-254163/9; FEA/B-76/219) Avail: NTIS HC A05/MF A01 CSCL 09B

Federally sponsored energy-related information is announced. The information on magnetic tape is primarily in the form of data files. However, there are also computer programs, data base reference services, and mathematical models. The items are listed under broad subject categories. The citations include title, responsible agency, dates of coverage, accession number, availability information, and abstract. Each entry is indexed by subject, originating agency, and accession number. GRA

N77-10942# D. P. Management Corp., Lexington, Mass.
A METHODOLOGY FOR EVALUATING ALTERNATIVE TECHNICAL AND INFORMATION MANAGEMENT APPROACHES TO PRIVACY REQUIREMENTS Final Report
Robert C. Goldstein, Henry H. Seward, and Richard L. Nolan
Jun. 1976 75 p
(Contract NBS-5-35935)
(PB-254048/2; NBS-TN-906) Avail: NTIS HC A04/MF A01 CSCL 09B

Cost becomes an early concern in applying privacy safeguards to any computerized record keeping system. To determine privacy cost impact a concrete and rigorous approach that permits repeated analysis of carefully documented assumptions is required. The application of that methodology to the technical requirements flowing from the Privacy Act of 1974 is presented. The privacy model contains algorithms reflecting resource expenditures for 56 distinct actions. Written as a FORTRAN program, the model produces several printouts that show the user the consequences of the input data. In addition to a total cost for conversion and an annual operating cost, the model provides subtotal costs for each compliance step. GRA

N77-10943# Comptroller General of the United States, Washington, D.C.
REPORT TO THE CONGRESS BY THE COMPTROLLER GENERAL OF THE UNITED STATES: MANAGERS NEED TO PROVIDE BETTER PROTECTION FOR FEDERAL AUTOMATIC DATA PROCESSING FACILITIES
10 May 1976 71 p Prepared by General Accounting Office, Washington, D. C.
(PB-254077/1; FGMSD-76-40; B-115369) Avail: NTIS MF A01; HC: US General Accounting Office, distribution section, P. O. Box 1020, Washington, D. C. 20013, $1.00 CSCL 09B

Government wide policies and practices used for determining physical security requirements at Federal data processing

installations are covered. The following items were examined: (1) policies and procedures regarding automatic data processing systems; (2) security techniques employed at 28 data processing installations; (3) Air Force, agriculture, transportation, state, and health, education, and welfare and the Veterans Administration; (4) types of data processing security used at selected government contractors, universities, private companies, a bank, and a local government; and (5) types of security problems experienced at 23 additional Federal data processing installations. GRA

N77-10944# Northwestern Univ., Evanston, Ill. Transportation Center.
THE EFFECTIVENESS AND FEASIBILITY OF A NETWORK OF TRANSPORTATION RESEARCH INFORMATION SERVICES (TRISNET) REGIONAL CENTER IN INFORMATION TRANSFER Final Report, Apr. 1974 - Jun. 1975
J. Rath Gustave, Ardwin Libman, Benjamin Jacobson, Jaime Silva, and Mary Roy Oct. 1975 39 p
(Contract DOT-OST-50090)
(PB-255489/7; DOT-TST-76-36) Avail: NTIS HC A03/MF A01 CSCL 05B

The National Network of Transportation Research Information Services (TRISNET) includes a series of regional centers to provide local access to the network and loans and photocopies of transportation documents cited in the TRIS abstracting/indexing services. The role of the regional center through the offer of services to the transportation community (state and local government and private industry) in the Chicago metropolitan area was investigated. The study of user behavior patterns and acceptance of individual services establishes regional center functions: document delivery, TRIS-On-Line searches, referral to other TRISNET components and user feedback to TRISNET management. GRA

N77-10945# National Micrographics Association, Silver Spring, Md.
REVIEW OF DEVELOPMENTS IN COMPUTER OUTPUT MICROFILM (COM) AND MICROGRAPHIC TECHNOLOGY, PRESENT AND FUTURE
Sep. 1976 57 p refs Presented at AGARD Lecture Series, Oslo, 25-26 Oct. 1976; Paris, 28-29 Oct. 1976; London, 1-2 Nov. 1976
(AGARD-LS-85; ISBN-92-835-1225-1) Avail: NTIS HC A04/MF A01

An up-to-date review is given of micrographic technology, computer input microfilm (CIM) and computer output microfilm (COM), as well as an indication of the market size and growth rate. After an account of the fundamentals of micrographics, COM recording techniques and recorders are described and CIM techniques reviewed. Other topics cover indexing and retrieval techniques, systems design, alphanumeric and graphic applications. Future trends in micrographic technology are indicated. For individual titles, see N77-10946 through N77-10953.

N77-10946# National Micrographics Association, Silver Spring, Md.
MICROGRAPHICS AND COM: A STATE-OF-THE-ART AND MARKET REPORT
Don M. Avedon *In* AGARD Rev. of Develop. in Computer Output Microfilm (COM) and Micrographic Technol., Present and Future Sep. 1976 6 p (For primary document see N77-10945 01-82)
Avail: NTIS HC A04/MF A01

An overview of micrographics, computer input microfilm and computer output microfilm at jet speed is given. The scope, the boundaries and the use of micrographics are discussed. Author

N77-10947# Baker (G. G.) and Associates, Surrey (England).
MICROGRAPHIC FUNDAMENTALS
G. G. Baker *In* AGARD Rev. of Develop. in Computer Output Microfilm (COM) and Micrographic Technol., Present and Future Sep. 1976 10 p (For primary document see N77-10945 01-82)
Avail: NTIS HC A04/MF A01

A general introduction to the technology of micrographics is given and the microforms in use in Europe, the equipment available and the concepts of recording, film processing and readout are described. Some of the common indexing methods are discussed and illustrated. Details and illustrations are also provided for film cartridges and cassettes, film duplicating equipment, jacketing equipment, fiche production equipment, automated fiche systems, aperture card equipment and microfilm cameras. Methods of computer output microfilm (COM) recording are described and two popular fiche formats used for COM operations are illustrated. Author

N77-10948# Micord Corp., Kingston, N. H.
COM RECORDING TECHNIQUES AND RECORDERS
George H. Harmon *In* AGARD Rev. of Develop. in Computer Output Microfilm (COM) and Micrographic Technol., Present and Future Sep. 1976 6 p (For primary document see N77-10945 01-82)
Avail: NTIS HC A04/MF A01

Various techniques for the conversion of data, techniques for character and vector generation, and the means for implementing the concepts in computer output microfilm recorders are described. Also included is a discussion of the various Computer Output Microfilmers available today. Mention is also made of the concepts of Computer Input from Microfilm. Author

N77-10949# Microfilm Sciences Corp., New York.
INDEXING AND RETRIEVAL TECHNIQUES
Franklin I. Bolnick *In* AGARD Rev. of Develop. in Computer Output Microfilm (COM) and Micrographic Technol., Present and Future Sep. 1976 6 p (For primary document see N77-10945 01-82)
Avail: NTIS HC A04/MF A01

A review of the state-of-the-art in available storage and retrieval methods and techniques used with micrographic systems is given. Roll film, fiche and aperture card systems with their manual, semi-automatic and fully automatic retrieval equipment are evaluated, analyzed and compared. The relationship of updatable microfilm to storage and retrieval systems are explained and evaluated. Author

N77-10950# Central Computer Agency, London (England).
THE SYSTEMS APPROACH TO COMPUTER OUTPUT MICROFILM
Bernard Terry *In* AGARD Rev. of Develop. in Computer Output Microfilm (COM) and Micrographic Technol., Present and Future Sep. 1976 5 p (For primary document see N77-10945 01-82)
Avail: NTIS HC A04/MF A01

The use of COM was primarily based on the need to escape from the avalanche of paper emanating from computer systems and to minimize the escalating costs of printing, duplication and distribution. The scope for the systems analyst to apply his experience to the tasks to be 'dumped' to microform was inhibited by the need to accept existing page layouts in order to effect the transfer from paper with the minimum of time and effort to maximize savings. However even within these limitations there are design options open to the analyst, and these are identified and explored with a view to optimizing benefits and cost savings. The range of COM techniques and hardware features, together with the systems implications, are described. The potential for developing novel output systems utilizing the particular advantages of COM is discussed. Author

N77-10951# Zytron Corp., Menlo Park, Calif.
APPLICATIONS: ALPHANUMERIC
Truett E. Airhart *In* AGARD Rev. of Develop. in Computer Output Microfilm (COM) and Micrographic Technol., Present and Future Sep. 1976 7 p (For primary document see N77-10945 01-82)
Avail: NTIS HC A04/MF A01

Alphanumeric applications of computer technology are discussed and the technological advances assessed. L.S.

N77-10952# Micord Corp., Kingston, N. H.
COM APPLICATIONS: GRAPHIC
George H. Harmon *In* AGARD Rev. of Develop. in Computer Output Microfilm (COM) and Micrographic Technol., Present and Future Sep. 1976 2 p (For primary document see N77-10945 01-82)
Avail: NTIS HC A04/MF A01

With the advanced design of Computer Output Microfilm recorders the possible applications for use are almost limitless. Nearly any symbol, or character can be created. Application areas

discussed range through business, finance, engineering, graphic arts, printing, publishing, education, and scientific research. The types of recordings described range from charts and graphs of financial records, engineering drawings, chemical reports, and satellite recordings, to color charts, printed circuit masters and animated movies. Author

N77-10953# National Micrographics Association, Silver Spring, Md.
BIBLIOGRAPHY OF MICROGRAPHICS
In AGARD Rev. of Develop. in Computer Output Microfilm (COM) and Micrographic Technol., Present and Future Sep. 1976 8 p refs (For primary document see N77-10945 01-82) Avail: NTIS HC A04/MF A01

A selection of publications, from 1966 to 1975, covering many aspects of micrographics is given. The items are listed chronologically, using the same numbering system as NMA's Micrographics Index, with the first two digits representing the year of publication. Entries have the same accession number in the Bibliography and in the Micrographics Index. Entries are indexed according to subject again using the same system as the Micrographics Index. Additional information on the content is provided in the brief annotation which is a part of each entry. The bibliography does not include journal articles. These, together with additional books, pamphlets and reports, can be found in the Micrographics Index and its Supplement. The Micrographics Index is designed to provide a cumulative and comprehensive information base, with supplements or updates appearing each year. Author

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N77-10954# General Electric Co., St. Petersburg, Fla. Automation and Control Lab.
PRODUCT SYSTEM PRODUCTIVITY RESEARCH: A COLLABORATIVE STUDY. VOLUME 1: EXECUTIVE SUMMARY
J. B. Gibbons Jan. 1976 46 p ref Revised Prepared in cooperation with MIT, Cambridge, Mass. 3 Vol.
(Grants NSF APR-75-16221; NSF APR-75-15334)
(PB-254646/3; NSF/RA-760116-Vol-1) Avail: NTIS HC A03/MF A01; also available in set of 3 reports as PB-254645-SET, HC $17.00/MF $4.75 CSCL 05C

The usefulness of the product system productivity research concept was determined as a means of exposing research needs in addition to those now recognized in university, industry, and NSF and other government research programs. The specific objectives were: (1) to develop and test a methodology based on the product system productivity research concept; and (2) to identify new topics for research in this trial of the methodology. The methodology is defined, the findings and conclusions of the investigation summarized, and the recommendations given for the implementation of a product system productivity research program. GRA

N77-10955# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab. Div.
PRODUCT SYSTEM PRODUCTIVITY RESEARCH: A COLLABORATIVE STUDY. VOLUME 2: PRODUCTIVITY, TECHNOLOGY AND PRODUCT SYSTEMS PRODUCTIVITY RESEARCH
J. L. Nevins, N. Kamrany, and W. E. Whitney Dec. 1976 266 p refs 3 Vol.
(Grant NSF APR-75-15334)
(PB-254647/1; R-928-Vol-2; NSF/RA-760117-Vol-2) Avail: NTIS HC A12/MF A01; also available in set of 3 reports as PB-254645-SET, HC $17.00/MF $4.75 CSCL 05C

The goals of this four month study were to: (1) examine the appropriateness of product system productivity research for guiding productivity enhancement efforts; (2) investigate the need for research applied to selected discrete parts manufacturing industries in the United States; (3) delineate the scope of the research effort required to increase productivity through the focusing mechanism of the product system and define the appropriate institutional arrangement; and (4) explore the possible role of government agencies. GRA

N77-10956# General Electric Co., Schenectady, N.Y. Automation and Control Lab.
PRODUCT SYSTEM PRODUCTIVITY RESEARCH: A COLLABORATIVE STUDY. VOLUME 3: METHODOLOGY AND RESEARCH NEEDS
J. B. Gibbons, P. F. Scott, A. P. Taylor, and B. R. White Jan. 1976 135 p refs 3 Vol.
(Grant NSF APR-75-16221)
(PB-254648/9; NSF/RA-760118-Vol-3) Avail: NTIS HC A07/MF A01; also available in set of 3 reports as PB-254645-SET, HC $17.00/MF $4.75 CSCL 05C

A means must be devised to select the industries to be addressed and the technical directions to be taken. The product system productivity research concept attacks these selection problems: (1) by identifying those industries important to the national economy which appear to be amenable to productivity improvement through new technological research; (2) by enabling researchers to attack the problems of these industries in a cost effective manner; and (3) by providing a comprehensive approach to the identification of research opportunities in these industries through the system analysis of all the factors contributing to product cost. GRA

N77-10957# Army War Coll., Carlisle Barracks, Pa.
OPPORTUNITIES FOR COST REDUCTIONS IN THE TESTING OF NEW MISSILE SYSTEMS Student Essay
Robert J. Feist 10 Nov. 1975 35 p refs
(AD-A024014) Avail: NTIS HC A03/MF A01 CSCL 16/4

The basic problem addressed is to identify new testing methods for the Army's new missile systems which can, in the short term, produce at less cost the increased quantities of improved quality test data required by materiel acquisition decision makers. Live trial firings, mathematical modeling and hardware-in-the-loop simulations were examined. Data were gathered from technical reports, Army regulations, staff studies, and personal interviews. The traditional testing method, live trial testing was found to be increasingly costly as the level of system and threat complexity grew. Mathematical modeling provided significant advantages, but the number of live firings required to develop and validate the model approximated the number required by a typical missile system test program in which all the test data were obtained from live firing. The hardware-in-the-loop offered significant advantages to both the developer and the tester. It was found to offer the best opportunities for cost reduction while providing the increased quantities of high quality data required. Author (GRA)

N77-10958# International Planning Management Corp., Bethesda, Md.
SMALL BUSINESS IN THE METALS INDUSTRY: A BACKGROUND STUDY Final Report
24 May 1976 88 p refs
(NSF Order 76-SP-0871)
(PB-255649/6; NSF/RA-760017) Avail: NTIS HC A05/MF A01 CSCL 05C

The principal small business roles in, and innovations of particular importance to, the metallurgical industry, together with associated planning and policy issues, marketing issues, and institutional arrangements are identified. The extraction and processing phases of the metals cycle are studied. Extraction includes all stages prior to metal processing: mining, benefication of ores, reduction, smelting, and refining of the pure metals. Processing includes alloying, heat treating, rolling, casting, and fabrication. Three broad areas were identified in which small business is actively involved: high technology, service companies, and secondary recovery. GRA

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation, and 44 Energy Production and Conversion.*

N77-10959# National Swedish Road and Traffic Research Inst., Stockholm.
MEASUREMENT OF THE BEARING CAPACITY OF ROADS. A COMPARISON BETWEEN FOUR MEASURING METHODS
Olle Andersson 1975 49 p refs Sponsored by Swed. Road Admin.
(VTI-61-A) Avail: NTIS HC A03/MF A01

The comparative investigation included a conventional static plate bearing test (SP), deflection measurement at transient drop hammer loading (DH), deflection measurement at heavy vibrator loading (HV), and determination of dynamic elastic modulus from measurements of propagation of elastic waves caused by a light vibrator (LV). All methods were tried regularly over one climate cycle, on test sections of a road at Brista near Arlanda airport and three sections on abandoned parts of shunt road 849 between E4 and E18 in the same area. Isolated measurements were also made in the city of Malmoe, Sturup airport near Malmoe, and E18 bypass near Oerebro, mostly full depth type of pavements. The four methods were judged with respect to their technical features, measuring capacity, and measuring costs. Seasonal variations were significant only on thick bituminous pavements and pavement on organic soil. On such measuring objects there is also a significant difference between static and nonstatic tests. Where high measuring capacity in mileage is important the results are in favor of neither static measurements, including Benkelman beam systems, nor existing wave propagation measuring systems. Author (ESA)

N77-10960# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
[ACTIVITIES OF THE DEPARTMENT OF TRANSPORT TECHNOLOGY] Biennial Review, 1973 - 1974
1974 115 p refs
Avail: NTIS HC A06/MF A01

The following research projects are reported on: transport systems assessment, structural mechanics, vehicle dynamics and control, fluid mechanics and propulsion, and transport environment. ESA

N77-10961# California State Univ., Los Angeles.
THE ROLE OF GOVERNMENT IN THE ALLOCATION OF RESOURCES TO TECHNOLOGICAL INNOVATION. VOLUME 1: EXECUTIVE SUMMARY Final Report
Harold J. Brumm, Jr. and John M. Hemphill, Jr. 1 Oct. 1975 22 p refs 3 Vol.
(Grant NSF RDA-74-23122)
(PB-252478/3; NSF/RDA-75/1/1-Vol-1) Avail: NTIS HC A02/MF A01; HC also available in set of 3 reports as PB-252477-SET, HC $14.00 CSCL 05A

A state-of-the-art review of the theoretical and empirical literature addressed to the role of government in the allocation of resources to technological innovation is reported. Criteria for government involvement in the direction and support of technological innovation and the expenditure mechanisms through which government does or should fund technological innovation in order to obtain an efficient allocation of resources are examined. An analytical report on the state of the art, a policy oriented summary of the analytical report and an annotated bibliography are presented. GRA

N77-10962# California State Univ., Los Angeles.
THE ROLE OF GOVERNMENT IN THE ALLOCATION OF RESOURCES TO TECHNICAL INNOVATION. VOLUME 2: SURVEY OF THE LITERATURE, POLICY GUIDELINES, AND AGENDA FOR FUTURE RESEARCH Final Report
Harold J. Brumm, Jr. and John M. Hemphill, Jr. Feb. 1976 108 p refs 3 Vol.
(Grant NSF RDA-74-23122)
(PB-252479/1; NSF/RDA-75/1/2-Vol-2) Avail: NTIS HC A06/MF A01; HC also available in set of 3 reports as PB-252477-SET, HC $14.00 CSCL 05A
For abstract, see N77-10961.

N77-10963# California State Univ., Los Angeles.
THE ROLE OF GOVERNMENT IN THE ALLOCATION OF RESOURCES TO TECHNOLOGICAL INNOVATION. VOLUME 3: ABSTRACTS/ANNOTATED BIBLIOGRAPHY Final Report
Harold J. Brumm, Jr. and John M. Hemphill, Jr. Feb. 1976 182 p refs 3 Vol.
(Grant NSF RDA-74-23122)
(PB-252480/9; NSF/RDA-75/1/3-Vol-3) Avail: NTIS HC A09/MF A01; HC also available in set of 3 reports as PB-252477-SET, HC $14.00 CSCL 05A
For abstract, see N77-10961.

N77-10964# Columbia Univ., New York. School of Engineering and Applied Science.
RESOURCE RECOVERY TECHNOLOGY FOR URBAN DECISION-MAKERS
Helmut W. Schulz, Bernard J. Bortz, Mounir Neamatalla, Ronald M. Szostak, and Godfred Tong Jan. 1976 127 p refs Sponsored in part by NSF
(PB-252458/5; NSF/RA-760026) Avail: NTIS HC A07/MF A01 CSCL 13B

Contents: Characteristics of municipal solid waste; Economic comparison of energy recovery processes; Economic factors in materials recovery; Biochemical conversion processes; Guide for decision making; Appendices (Financial and organizational arrangements, Pyrolysis of dewatered sewage sludge, Calculation of economic figures of merit, Sample request for proposal, advisory committee and research staff). GRA

N77-10965# Illinois Univ., Chicago. Coll. of Engineering.
DATA MANAGEMENT METHODS FOR URBAN MASS TRANSPORTATION SYSTEMS
Roland Priemer and Marshall L. Silver 15 Sep. 1975 77 p refs
(PB-254798/2; UMTA-IL-11-0007-75-1) Avail: NTIS HC A05/MF A01 CSCL 13B

A computer based data management and retrieval system for the urban mass transportation industry is described. The system is designed to aid the transportation planner, engineer, and manager in solving recurring problems associated with: (1) collection; (2) categorization and synthesis; (3) storage, and (4) retrieval of urban mass transportation information. The system is designed to be used by personnel without formal computer training with the everyday vocabulary associated with many classes of rapid transit operation, evaluation, and studies. The features and use of an example system are described for rail rapid transit noise abatement studies. GRA

N77-10966# Massachusetts Inst. of Tech., Cambridge. Center for Policy Alternatives.
NATIONAL SUPPORT FOR SCIENCE AND TECHNOLOGY: AN EXAMINATION OF FOREIGN EXPERIENCE. VOLUME 2: COUNTRY MONOGRAPHS Final Report
Nicholas A. Ashford 21 Nov. 1975 832 p
(Contract NSF RDA-73-07228)
(PB-253364/4; CPA-75-12-Vol-2; NSF/RDA-73/5/3-Vol-2)
Avail: NTIS HC A99/MF A01 CSCL 05A

A comparative analysis is made across five countries (France, Germany, the Netherlands, the United Kingdom and Japan) of

the ways in which governments influence technological change. This influence operates through government instruments designed or intended to affect: (1) the innovation process, (2) the intellectual resource base, and (3) the adverse consequences of technology such as deterioration of the environment and labor's resistance to technological change. For the purpose of analysis, twelve categories were constructed--each containing a number of diverse government programs of instruments affecting one or more of the three areas described above. GRA

N77-10967# Georgia Inst. of Tech., Atlanta. Advanced Technology and Science Studies Group.
TECHNICAL INNOVATION: A CRITICAL REVIEW OF CURRENT KNOWLEDGE. EXECUTIVE SUMMARY Final Report
Patrick Kelly and Melvin Kranzberg Feb. 1975 29 p
(Grant NSF RDA-73-07230)
(PB-249104/1; NSF/RDA-73-25-5) Avail: NTIS HC A03/MF A01 CSCL 05A

An executive summary to the report Technological Innovation: A Critical Review of Current Knowledge is presented. Research projects, and conceptual framework are described. A table of contents for the four volumes is also included. GRA

N77-10968# Washington Univ., Seattle. Urban Transportation Program.
A PRELIMINARY SYSTEMS DESIGN FOR A MULTI-PURPOSE TRANSIT PLANNING AND MANAGEMENT INFORMATION SYSTEM
Thomas Walter Friedman Mar. 1976 102 p refs
(Contract FWPCA-WA-11-0005)
(PB-255178/6; RR-76-1; UMTA-WA-11-0005-76-1) Avail: NTIS HC A06/MF A01 CSCL 13B

A preliminary systems design for a multi-purpose transit planning and management information system is presented. It conceptualizes two such information systems: one for the automation of transit schedule data for the production of scheduling related reports, and the other for the automation of transit schedule data and street network data for a general transit information system. While the former system is designed to produce the types of reports currently manually produced and in use by the transit industry, the latter system is intended to provide an automated data base for the planning and marketing of transit services. Transit properties and others with an efficient file structure for organizing schedule data for the production of various types of output based on the concept of random access search are provided. GRA

N77-10969# Michigan Univ., Ann Arbor. Highway Safety Research Inst.
RESPONSES OF VEHICLES TO PAVEMENT UNDULATIONS Final Report
Thomas M. Post and James E. Bernard Mar. 1976 44 p refs
(PB-255681/9; UM-HSRI-76-6; FHWA/SES-76-07) Avail: NTIS HC A03/MF A01 CSCL 13B

The ride response of two passenger vehicles to long configuration, large amplitude pavement undulations was simulated with a computer model. Passenger accelerations, spring deflections, tire forces, and ground clearances were estimated at speeds up to 60 m.p.h. Two pavement undulation configurations were tested. It was concluded that the 16 foot by 6 inch configuration is not acceptable because the Buick station wagon would have zero ground clearance at 15 to 20 m.p.h. and the Mustang at 30 to 50 m.p.h. It was recommended that a trial installation of lesser amplitude be monitored over some length of time before pavement undulations are recommended as a widespread speed control device. GRA

N77-10970# Transportation Research Board, Washington, D.C.
UTILITY FACILITIES IN TRANSPORTATION CORRIDORS
G. W. Bradley 1976 50 p refs
(PB-255635/5; TRB/TRR-571; ISBN-0-309-02484-6) Avail: NTIS HC A03/MF A01 CSCL 13B

This record deals with: (1) the concept of an energy corridor to establish a precedent for the orderly, controlled transmission of sources of all types of energy from supplier to user; (2) the state of the art of common trenching of utilities; (3) an examination of the increasing complexities involved in providing essential utility and transportation services; (4) a discussion of wastewater recycling along transportation corridors; and (5) a highlighting of the severity and complexity of the utility pole accident problem and a recommendation for further specific actions. GRA

N77-10971# American Public Transit Association, Washington, D.C.
PROCEEDINGS OF THE URBAN MASS TRANSPORTATION ADMINISTRATION/AMERICAN PUBLIC TRANSIT ASSOCIATION RESEARCH AND DEVELOPMENT PRIORITIES CONFERENCE
May 1976 131 p refs Held at Arlington, Va., 19-20 Feb. 1976 Sponsored by the Urban Mass Transportation Dept., Washington, D.C.
(PB-255898/9; UMTA-DC-06-0136-76-1) Avail: NTIS HC A07/MF A01 CSCL 13B

Material that was presented at the Urban Mass Transportation Administration/American Public Transit Association Research and Development Priorities Conference is reviewed. The papers specifically address the following aspects of urban transportation research and development: bus and paratransit technology; rail transit technology; new systems and automation; socioeconomic research and special projects; service and methods demonstrations; priorities and balance in UMTA research and development; delivery systems for putting results of research and development into service; transit management; and planning methodology. GRA

N77-10972# Multisystems, Inc., Cambridge, Mass.
OPERATIONAL IMPLICATIONS OF A MAJOR MODAL DIVERSION TO TRANSIT: A MACRO-ANALYSIS Final Report
James H. Batchelder, Larry S. Englisher, Brian C. Kullman, and Kenneth L. Sobel Apr. 1976 124 p refs
(Contract DOT-OS-50266)
(PB-255921/9; DOT-TST-76-72) Avail: NTIS HC A06/MF A01 CSCL 13B

The implications of dramatic increases in transit patronage on system structure and performance are examined. Models were developed to examine the cost and service attributes of a variety of system components, including express bus, exclusive lane operation, subscription service, dial-a-ride, and several route based feeder options. These models were applied in a regional context over a range of patronage assumptions to evaluate both the individual components and the effects resulting from various service combinations. Insights into the structure of integrated transit systems and the expansion of these systems to serve increasing shares of urban travel were provided. GRA

N77-10973# California State Office of Planning and Research, Sacramento.
A STATE ROLE IN COMMUNITY DEVELOPMENT
Jun. 1976 119 p refs
(PB-255537/3; EDA-76-016) Avail: NTIS HC A06/MF A01 CSCL 13B

How state government can become more responsive to local and urban needs through its policies, plans and programs is examined. While federal programs are being organized to meet local comprehensive community development needs, state programs continue emphasis on many objectives. GRA

N77-10974# Hittman Associates, Inc., Columbia, Md.
UNDERGROUND COAL MINING: AN ASSESSMENT OF TECHNOLOGY Final Report
Jul. 1976 475 p refs Prepared in cooperation with Pa. State Univ., Univ. Park and George Washington Univ., Washington, D. C. Sponsored by EPRI
(PB-255726/2; EPRI-AF-219) Avail: NTIS HC A20/MF A01 CSCL 08I

The methodology, techniques, and processes of technology assessment are applied to domestic underground mining of coal. Advanced technologies and systems for increased production of deep mined coal are identified and alternative R and D and institutional strategies that may make such technologies viable are developed. Major areas of uncertainty facing the future of the underground coal mining industry are stipulated. The sensitivity of increased production to these uncertainties are determined, and strategies and timetables for the resolution of the uncertainties

are formulated. Major alternatives for filling institutional gaps, if any, between the various industries involved in the extraction and utilization of underground mined coal are defined. GRA

88 SPACE SCIENCES (GENERAL)

N77-10975*# State Univ. of New York, Albany.
PRELIMINARY STUDY OF CONTAMINANT PARTICULATES AROUND SKYLAB
D. W. Schuerman and J. L. Weinberg Washington NASA Oct. 1976 84 p
(Contract NAS8-31902)
(NASA-CR-2759; M-187) Avail: NTIS HC A05/MF A01 CSCL 03C

Techniques originally developed for the Skylab T025 contamination experiment were applied to S052 white-light coronagraph data in a preliminary study to investigate particulates around Skylab. Periods were selected which contained some contamination, even though there were no apparent dumps or vents during these periods. Velocity and size distributions were determined from optical data for particles within 200 meters of the spacecraft. Both photographic (61 particle tracks) and video (34 particles) observations yield an upper limit on particle radius of 100 micrometers. Selected photometric data from the S073 zodiacal light experiment during mission SL-2 were also examined for evidence of contamination. Author

N77-10976# Royal Greenwich Observatory, Herstmonceux (England). Time and Latitude Service.
GREENWICH TIME REPORT, JULY - SEPTEMBER 1975
Sep. 1975 17 p
Avail: NTIS HC A02/MF A01

Greenwich time and latitude observations are presented. Radio time signals and standard frequency emissions are included. ESA

N77-10977# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY PHYSICAL SCIENCES AND TECHNOLOGY NO. 2
4 Nov. 1976 54 p refs Transl. into ENGLISH from various Russian articles
(JPRS-68167) Avail: NTIS HC A04/MF A01

Eleven articles from scientific publications are presented in translation. Soviet progress is reported in thematic mapping, satellite defense systems, lunar sample research, climatology, geochemistry, oceanography, and amino acids. Related technological advances are discussed. A.H.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N77-10978 Massachusetts Univ., Amherst.
THE 2.7 GHz POLARIZATION AND FLUX DENSITY MEASUREMENTS OF VARIABLE RADIO SOURCES Ph.D. Thesis
John Edward Kapitzky 1976 245 p
Avail: Univ. Microfilms Order No. 76-22269

Extragalactic radio sources are observed at 11 cm on the NRAO 300 foot radio telescope in Green Bank, West Virginia for roughly six consecutive days every three to four months. Each observed source drifted through the beam patterns of three azimuthally-aligned, linearly polarized feeds once a day. The radiometer attached to one of the feeds was in a conventional load-switching configuration. Each of the other two feeds was connected to a radiometer whose input was switched between two orthogonal dipoles contained within the feed (polarization-switching). The orientations of the dipole pairs within the three feeds and the combination of load-switching and polarization-switching theoretically allowed determination of total flux, degree of polarization, and polarization position angle for each observed radio source. The results at 11 cm were combined with flux density observations at 1.9 and 3.8 cm made at the Haystack Radio Observatory and with flux observations at 9.6 mm made with the NRAO 36 foot Kitt Peak radio telescope. Dissert. Abstr.

N77-10979 Indiana Univ., Bloomington.
LUMINOSITY CRITERIA IN O STARS Ph.D. Thesis
Ronald Stephen Chaldu 1976 234 p
Avail: Univ. Microfilms Order No. 76-21574

The possibility of using the equivalent widths of the N III lambda lambda 4634-40-42 and He II lambda 4686 lines in O star spectra as luminosity indicators was examined. Several stars were observed with a low resolution signal averaging spectrometer which produces spectral scans of high photometric quality. Computed scans of artificial spectra which had a variety of the absorption and emission lines characteristic of the O spectral types, both with and without the broad features, were compared to the observed scans, and evidence of the broad features in a number of O stars was found. The features are particularly strong in luminosity class I and III stars, but are weak or absent in some stars that would ordinarily be expected to show them. Hence, there does not seem to be a one-to-one correlation between the strengths of the features and M sub v. Furthermore, variations in the strengths of the features occur. Since the light from these broad features is detected photometrically, the photometric equivalent widths are not useful luminosity indicators. Dissert. Abstr.

N77-10980 Indiana Univ., Bloomington.
THE UNDERLYING OLD STELLAR POPULATION OF THE LARGE MAGELLANIC CLOUD Ph.D. Thesis
Eduardo Julio Hardy 1976 167 p
Avail: Univ. Microfilms Order No. 76-21583

So as to examine the structure of the old population of the disk of the LMC, a number of regions, 3.4' in diameter each, free of supergiants, and situated in and near the bar, were studied. Photographic observations in B and V and photoelectric observations in the integrated light of the UBV and DDO systems were used. Dissert. Abstr.

N77-10981# Royal Observatory, Edinburgh (Scotland).
A CATALOGUE OF SOUTHERN PECULIAR GALAXIES FROM THE UK SCHMIDT SURVEY: PRELIMINARY REDUCTIONS OF 36 FIELDS
H. C. Arp (Hale Obs., Pasadena, Calif.) and Barry F. Madore (Cambridge Univ., Engl.) [1975] 64 p Sponsored by Sci. Res. Council and Edinburgh Univ.
Avail: NTIS HC A04/MF A01

A catalog of all peculiar galaxies measured on the plates of the UK Schmidt southern sky survey is presented in order to provide quick-look reductions. Reductions to right ascension and declination (1975.0) used the plate center, defined by the telescope at the time of exposure, and (x, y) measurements of the four plate corners. Reduction formulas given by Konig (1962) were used. The positives were checked with respect to bright field galaxies and conspicuous globular clusters. In addition some objects appear on several fields or on several plates of the same fields. From both methods of comparison the quoted positions appear to be accurate to plus or minus 2 minutes of arc. ESA

N77-10982# Strasbourg Univ. (France). Observatory.
STELLAR DATA CENTER INFORMATION BULLETIN NO. 9
C. Jaschek, ed. Aug. 1975 35 p
Avail: NTIS HC A03/MF A01

The bulletin contains a few short notes on radial velocities of southern stars and the catalogs available at the Stellar Data Center. Information on data distribution on microform are provided. ESA

N77-10983# Engins Matra, Velizy (France). Space Div.
A LARGE INFRARED TELESCOPE FOR SPACELAB, PHASE A, VOLUME 1 Final Report
15 Jun. 1976 282 p Prepared jointly with Tech. Phys. Dienst TNO and Rech. et Etudes d'Opt. et de Sci. Connexes 3 Vol.
(Contract ESTEC-2507/75-PP)
(Rept-60/181-Vol-1; ESA-CR(P)-833-Vol-1) Avail: NTIS

HC A13/MF A01

Several trade-off studies and comparative analyses were performed in order to determine a large infrared telescope baseline and, in particular, the aperture diameter for flight onboard Spacelab. A comparative cost analysis was carried out with primary mirror diameter and f-numbers as parameters, taking into account the multi-mission aspect of the program. Not only the telescope development and production costs but also the launch cost and associated expenses were considered to obtain figures for the cost of an overall program extending over several years and several flights. The overall cost analysis is supported by a subsystem level analysis where the contribution of the mirror blank, optical element figuring, structure, and other less important elements have been parameterized. System definition, system analysis, optical system, and thermal design are discussed. ESA

N77-10984# Federal Council for Science and Technology, Washington, D.C.
REPORT OF THE SOLAR ASTRONOMY TASK FORCE TO THE AD HOC INTERAGENCY COORDINATING COMMITTEE ON ASTRONOMY Final Report
Jun. 1975 219 p Sponsored in part by NSF
(PB-252824/8; ICCA-75/1) Avail: NTIS HC A10/MF A01 CSCL 03B

United States solar astronomy activities are surveyed. Agency program objectives and mission requirements, activities in support of the program, and money and manpower expenditures are included. The scope of solar astrophysics is defined, and the present state of knowledge is outlined. Federally supported solar research is described in detail, by major institution and by program category. A coordinated national program of solar astrophysics is discussed in terms of objectives and resources and the particular importance of the Sacramento Peak Observatory and the Solar Maximum Mission to this national program. GRA

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N77-10985*# Transemantics, Inc., Washington, D.C.
ON THE POSSIBLE CONNECTION BETWEEN THE AMOUNT OF GAS IN GALAXIES, THE ACTIVITY OF THEIR NUCLEI AND THEIR BELONGING TO A CLUSTER
B. V. Komberg NASA Oct. 1976 28 p refs Transl. into ENGLISH of Report PR-274, Academy of Sciences USSR, Inst. of Space Res., Moscow, 1976 p 1-23
(Contract NASw-2792)
(NASA-TT-F-17263) Avail: NTIS HC A03/MF A01 CSCL 03C

Optical and radio wavelength data available on fast S- and E-galaxies in regular clusters were analyzed. These galaxies are deficient in gas, have slower star formation rates and less active nuclei when compared to similar field galaxies. The slow massive galaxies in central regions of rich clusters, on the contrary, contain more gas and have more active nuclei. Author

N77-10986# Technische Universitaet, Munich (West Germany). Inst. fuer Astronomische und Physikalische Geodaesie.
SELF ADJOINED BOUNDARY VALUE PROBLEMS IN CELESTIAL MECHANICS AND SATELLITE GEODESY [SELBSTADJUNGIERTE RANDWERTAUFGABEN IN HIMMELSMECHANIK UND SATELLITENGEODAESIE]
Manfred Schneider 1976 26 p refs In GERMAN Presented at the Math. Colloq. of the Univ. of Giessen, West Ger., 16 Jan. 1976 Sponsored by Deut. Forschungsgemeinschaft
(TUM-MITT-131) Avail: NTIS HC A03/MF A01

The possibility of solving celestial mechanics and satellite geodesy problems using self adjoined boundary values was investigated. The self adjoined boundary value problem was formulated and solved using the method of an infinite number of variables. The method was applied to celestial mechanics and satellite geodesy problems in general and to the specific problem of calculating reference orbits. ESA

N77-10987# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
THE NATURE OF OPTICAL VARIABILITY OF X-RAY BINARIES CYG X-2=V1341 CYG AND SCO X-1=V818 SCO
V. M. Lyuty (Sternberg Astron. Inst.) and R. A. Sunyaev 1976 38 p refs
(PR-258) Avail: NTIS HC A03/MF A01

The results of UBV observations of Cyg X-2 and Sco X-1 during 1974-75 are presented. The rapid irregular variability of optical radiation of Cyg X-2 was detected. The full amplitude of irregular variability is of the order of 1 mag in the filter B. The semi-amplitude of the periodical component in the light curve of Cyg X-2 and Sco X-1 does not exceed 0.1 mag. Such a small amplitude of the periodical component may be a consequence of the existence of the accreting disc around X-ray source, which contributes sufficiently to the optical brightness of the system. The optical radiation spectrum of the disc was found, and it is shown that the contribution of the disc to the optical brightness of the binary may exceed the contribution of the hot spot on the surface of the normal star heated by X-rays.
Author (ESA)

N77-10988# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
THE IMPORT OF THE ALFVEN SURFACE FOR THE X-RAY PULSE FORMATION IN ACCRETING PULSARS
M. M. Basko and R. A. Sunyaev 1976 17 p refs Submitted for publication
(PR-267) Avail: NTIS HC A02/MF A01

A model is proposed for the X-ray pulsation of Her X-1 and Cen X-3. It is suggested that if accretion onto a magnetized neutron star proceeds through the disk, the plasma layer occupying some part of the Alfven surface and spinning together with the neutron star regularly shields the bright spots at magnetic poles where the main accretion energy is released. This causes the observed hard X-ray flux to pulsate. The plasma layer on the Alfven surface is a source of weakly pulsating soft X-ray flux. This mechanism is exemplified for Her X-1. Author (ESA)

N77-10989# European Space Operations Center, Darmstadt (West Germany).
THE SIMULATION OF NON-ISOLATED EXPANDING GRAVITATIONAL SYSTEMS.
G. Janin and M. J. Haggerty (Texas Univ., Austin) 1974 6 p refs Presented at the Intern. Astron. Union Symp. No. 69 on the Dyn. of Stellar Systems, Besancon, France, 9-13 Sep. 1974
Avail: NTIS HC A02/MF A01

Numerical experiments on the gravitational N-body problem for star clusters are reviewed for the case of nonisolated systems. The effect of an external field on expanding cubical systems is discussed. Author (ESA)

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N77-10338*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ATMOSPHERIC ENGINEERING OF MARS
R. D. MacElroy and M. M. Averner *In its* Advan. in Eng. Sci., Vol. 3 1976 p 1203-1214 refs (For primary document see N77-10305 01-31)
Avail: NTIS HC A20/MF A01 CSCL 03B

N77-10339*# Stanford Research Inst., Menlo Park, Calif.
CREATION OF AN ARTIFICIAL ATMOSPHERE ON THE MOON
Richard R. Vondrak *In* NASA. Langley Res. Center Advan. in Eng. Sci., Vol. 3 1976 p 1215-1223 refs (For primary document

see N77-10305 01-31)
Avail: NTIS HC A20/MF A01

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N77-10990*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPILATION OF FLARES AND TRANSIENTS OBSERVED BY THE S-056 SOLAR X-RAY TELESCOPE DURING THE SKYLAB MISSIONS
D. M. Speich, J. B. Smith, Jr., E. J. Reichmann, J. P. McGuire, J. A. Vorpahl (Aerospace Corp., Los Angeles, Calif.), and D. L. McKenzie (Aerospace Corp., Los Angeles, Calif.) Sep. 1976 29 p refs
(NASA-TM-X-73346) Avail: NTIS HC A03/MF A01 CSCL 03B

During the manned operation of the Skylab Apollo Telescope Mount, the Marshall Space Flight Center/The Aerospace Corporation solar X-ray telescope (S-056) observed many solar flares and transient solar phenomena. Those X-ray observations are correlated with events reported by H-alpha observers and those recorded by integrating X-ray satellite detectors. Data included for individual events are: (1) type of H-alpha activity; (2) H-alpha begin, maximum, and end times; (3) SOLRAD 9 or VELA X-ray (1 to 8 A) peak flux and time of peak flux; (4) begin time of S-056 observations; (5) approximate heliographic location; and (6) Boulder and McMath active region numbers.
Author

N77-10991*# Transemantics, Inc., Washington, D.C.
THE POSSIBILITY OF INVESTIGATING THE SOLAR CORONA BY MEANS OF PROLONGED RADIOSONDE OBSERVATION
O. G. Onishchenko and G. A. Mersov NASA Oct. 1976 18 p refs Transl. into ENGLISH of "O Vozmozhnosti Issledovaniya Solnechnoy Korony s Pomoshchyu Dlitelnogo Radiozondirovaniya" Rept. Pr-265, Inst. of Space Res., Acad. of Sci. of the USSR, Moscow, 1976 p 1-14
(Contract NASw-2792)
(NASA-TT-F-17271; Pr-265) Avail: NTIS HC A02/MF A01 CSCL 03C

A program is proposed for investigating the solar corona by the method of radiosonde observation by means of a space sonde put into a counter-terrestrial orbit. For determination of the electron concentration, it is proposed that the method of measuring group delay on two coherent radio frequencies be used. It is shown that only prolonged observations of the Faraday effect make it possible to determine the value of the product of the electron concentration by the intensity of the magnetic field and its sector structure. Using combined measurements of the polarization plane deflection angle and group delay, the electron concentration and the magnetic field of the dense corona regions are determined.
Author

N77-10992# Cologne Univ. (West Germany). Inst. fuer Geophysik und Meteorologie.
INVESTIGATION OF THE SOLAR FRAUNHOFER SPECTRUM IN THE HUGGINS BAND RANGE OF OZONE (315 - 338 nm) CONSIDERING ADDITIONAL OZONE ABSORPTION [EINE UNTERSUCHUNG DES SOLAREN FRAUNHOFERSPEKTRUMS IM BEREICH DER HUGGINS-BANDE DES OZONS (315 - 338 nm) UNTER BERUECKSICHTIGUNG ZUSAETZLICHER OZONABSORPTION]
Wolfgang Ruge Feb. 1975 89 p refs In GERMAN
(MITT-21) Avail: NTIS HC A05/MF A01

The measurement technology is described for the use of a self-made spectrograph with the sun as a light source for measurement within the Huggins band of ozone. The equipment allows simultaneous measurement of the vertical ozone profile and the temperature of the atmosphere, based on the temperature effect of the Huggins band. The accuracy of the method is discussed.
ESA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N77-10993*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE SOLAR GAMMA RAY SPECTRUM BETWEEN 4 AND 8 MeV
R. Ramaty, B. Kozlovsky (Tel Aviv Univ. Israel), and A. N. Suri (Computer Sciences Corp., Silver Spring, Md.) Oct. 1976 57 p refs Submitted for publication
(NASA-TM-X-71209; X-660-76-229) Avail: NTIS HC A04/MF A01 CSCL 03C

The properties of nuclear gamma ray emission in the 4 to 8 MeV range were evaluated. This emission consists of broad and narrow lines resulting from nuclear reactions of energetic H, He, C and O nuclei with ambient matter. Calculations were compared with observations of the 1972, August 4 flare and show that: (1) essentially all the observed radiation in the 4 to 8 MeV region is to the superposition of broad and narrow lines of nuclear origin with almost no contribution from other mechanisms; (2) the accelerated particles in the energy region from about 10 to 100 MeV/amu have a relatively flat Energy spectrum; (3) the calculated gamma ray spectrum, obtained from an isotropic distribution of accelerated particles, fits the observed spectrum better than the spectrum derived from an anisotropic distribution for which the particles' velocity vectors point towards the photosphere; and (4) it is possible to set a stringent upper limit on the ratio of relativistic electrons to protons in flares, consistent with the small, but finite, electron-to-proton ratio in galactic cosmic rays.
Author

N77-10994# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
ON X-RAYS OF DOUBLE WOLF-RAYET STARS
O. F. Prilutsky and V. V. Usov 1976 12 p refs
(D-197) Avail: NTIS HC A02/MF A01

It is shown that the close binary systems must be the rather intensive sources of X-radiation if one or both components of these systems are young massive stars with strong outflow of matter from them (Wolf-Rayet-type stars and OB supergiants). X-radiation of such binary systems is stimulated by gas heating behind the front of shock waves formed as a result of collision of gas outflowing from one component either with the second star surface or with its magnetosphere or with gas outflowing from the second star. The most possible candidates of X-ray sources among double Wolf-Rayet stars are gamma 2 Vel and V 444 Cyg.
Author (ESA)

99 GENERAL

No abstracts in this category.

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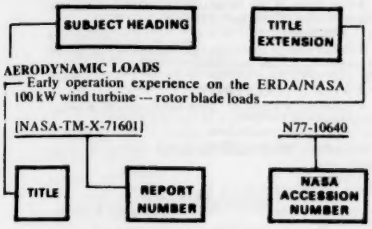

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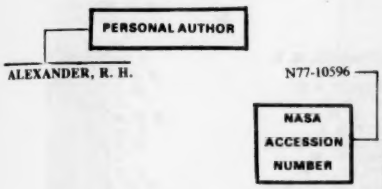

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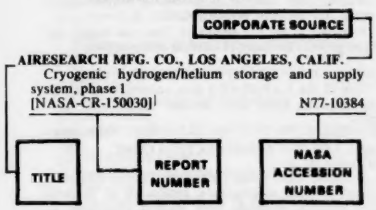

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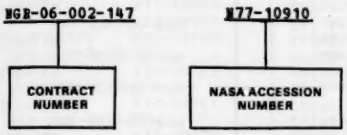

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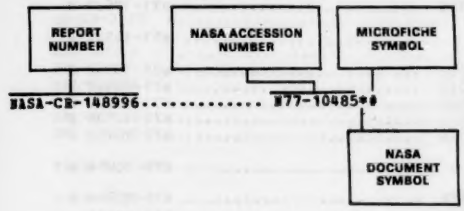

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NASA-CR-149104 ..... N77-10611*#
NASA-CR-149105 ..... N77-10801*#
NASA-CR-149106 ..... N77-10060*#
NASA-CR-149107 ..... N77-10061*#
NASA-CR-149141 ..... N77-10768*#
NASA-CR-149142 ..... N77-10515*#
NASA-CR-149143 ..... N77-10621*#
NASA-CR-149144 ..... N77-10138*#
NASA-CR-149980 ..... N77-10433*#
NASA-CR-150022 ..... N77-10806*#
NASA-CR-150024 ..... N77-10610*#
NASA-CR-150030 ..... N77-10384*#
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NASA-CR-150032 ..... N77-10638*#
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NASA-CR-150036 ..... N77-10540*#
NASA-CR-150041 ..... N77-10614*#
NASA-CR-150042 ..... N77-10615*#
NASA-CR-150044 ..... N77-10928*#
NASA-CR-150965 ..... N77-10143*#
NASA-CR-150976 ..... N77-10593*#
NASA-CR-151004 ..... N77-10792*#
NASA-CR-151028 ..... N77-10496*#
NASA-CR-151029 ..... N77-10612*#
NASA-CR-151030 ..... N77-10468*#
NASA-CR-151031 ..... N77-10809*#
NASA-CR-151033 ..... N77-10494*#
NASA-CR-151034 ..... N77-10144*#
NASA-CR-151085 ..... N77-10131*#
NASA-CR-151087 ..... N77-10607*#
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NASA-TM-X-71209 ..... N77-10993*#
NASA-TM-X-71601 ..... N77-10640*#
NASA-TM-X-71915 ..... N77-10810*#
NASA-TM-X-72600 ..... N77-10115*#
NASA-TM-X-73177 ..... N77-10691*#
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NASA-TM-X-73347 ..... N77-10608*#
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NASA-TM-X-73446 ..... N77-10119*#
NASA-TM-X-73456 ..... N77-10160*#
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NASA-TM-X-73469 ..... N77-10154*#
NASA-TM-X-73472 ..... N77-10557*#
NASA-TM-X-73473 ..... N77-10062*#
NASA-TM-X-73474 ..... N77-10558*#
NASA-TM-X-73476 ..... N77-10165*#
NASA-TM-X-73479 ..... N77-10183*#
NASA-TM-X-73483 ..... N77-10933*#
NASA-TM-X-73487 ..... N77-10116*#
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NASA-TM-X-73503 ..... N77-10152*#
NASA-TM-X-73505 ..... N77-10641*#
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NASA-TM-X-73513 ..... N77-10435*#
NASA-TM-X-73514 ..... N77-10153*#
NASA-TM-X-73517 ..... N77-10141*#
NASA-TM-X-73524 ..... N77-10059*#
NASA-TM-X-73525 ..... N77-10200*#
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NASA-TM-X-73975 ..... N77-10791*#
NASA-TM-X-73976 ..... N77-10802*#
NASA-TM-X-73977 ..... N77-10065*#

NASA-TM-X-74156 ..... N77-10486*#
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NASA-TN-D-8322 ..... N77-10732*#
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NASA-TT-F-17131 ..... N77-10776*#
NASA-TT-F-17141 ..... N77-10909*#
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NASA-TT-F-17204 ..... N77-10878*#
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NASA-TT-F-17212 ..... N77-10197*#
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NBSIR-76-1056 ..... N77-10687 #
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NIH/NHLI-N01-HB-3-2953-2 ..... N77-10787 #
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NIOSH/TC/R-003 ..... N77-10796 #
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NOAA-TM-NWS-WR-106 ..... N77-10761 #

NOAA-TR-ERL-356 ..... N77-10760 #

NOAA-TR-NESS-73 ..... N77-10763 #

NOAA-TR-NWS-19 ..... N77-10627 #

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NSF/RA-760059 ..... N77-10672 #
NSF/RA-760071 ..... N77-10677 #
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NSF/RA/N-75-233 ..... N77-10674 #
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NSF/RANN/AER-72-03478-A03/FR/7 ..... N77-10674 #
NSF/RANN/AER-72-03478-A04/TR76 ..... N77-10672 #
NSF/RANN/SE/AER-72-03579/A05 ..... N77-10685 #
NSF/RANN/SE/AER-74-09186 ..... N77-10675 #
NSF/RANN/SE/AER73-07957/PR-76 ..... N77-10678 #
NSF/RANN/SE/AER75-19576/PR-75 ..... N77-10677 #
NSF/RANN/SE/GI-34979/TR/75/8 ..... N77-10668 #
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NSWC/WOL/TR-75-68 ..... N77-10819 #
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NSWC/WOL/TR-75-136 ..... N77-10526 #
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OWRT-A-061-NY(1) ..... N77-10628 #

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PA-TR-4858 ..... N77-10227 #
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PB-249104/1 ..... N77-10967 #
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PB-252211/8 ..... N77-10456 #
PB-252220/9 ..... N77-10563 #
PB-252320/7 ..... N77-10483 #
PB-252356/1 ..... N77-10387 #
PB-252404/9 ..... N77-10568 #
PB-252409/8 ..... N77-10672 #
PB-252417/1 ..... N77-10087 #
PB-252428/8 ..... N77-10939 #
PB-252433/8 ..... N77-10174 #
PB-252437/9 ..... N77-10175 #
PB-252440/3 ..... N77-10882 #
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PB-252458/5 ..... N77-10964 #
PB-252462/7 ..... N77-10717 #
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PB-252473/4 ..... N77-10623 #
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PB-252478/3 ..... N77-10961 #
PB-252479/1 ..... N77-10962 #
PB-252480/9 ..... N77-10963 #
PB-252485/8 ..... N77-10662 #
PB-252486/6 ..... N77-10663 #
PB-252502/0 ..... N77-10389 #
PB-252504/6 ..... N77-10625 #
PB-252539/2 ..... N77-10674 #
PB-252540/0 ..... N77-10172 #
PB-252561/6 ..... N77-10788 #
PB-252592/1 ..... N77-10675 #
PB-252597/0 ..... N77-10385 #
PB-252608/5 ..... N77-10676 #
PB-252638/2 ..... N77-10390 #
PB-252640/8 ..... N77-10668 #
PB-252642/4 ..... N77-10626 #
PB-252687/9 ..... N77-10883 #
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PB-252695/2 ..... N77-10796 #
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PB-254077/1 ..... N77-10943 #
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PB-254167/0 ..... N77-10686 #
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PB-254307/2 ..... N77-10710 #
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PB-254879/0 ..... N77-10678 #
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QPR-7 ..... N77-10586*#
QPR-9 ..... N77-10683 #

QR-2 ..... N77-10677 #
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